CANADA'S GREEN BUILDING ENGINE

Market Impact and Opportunities in a Critical Decade

CANADA GREEN BUILDING COUNCIL • CONSEIL DU BÂTIMENT DURABLE DU CANADA •

ACKNOWLEDGMENTS

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About Canada Green Building Council

The Canada Green Building Council (cagbc.org) is a leading national non-partisan not-for-profit organization dedicated to accelerating the transformation to high-performing, healthy green buildings, homes, and communities throughout Canada. CaGBC is a leading green building education provider and conducts extensive research on key environmental and economic issues associated with green building. CaGBC helps governments identify and lower barriers to green building, owners and operators adapt to change, and companies identify and leverage opportunities in the green building marketplace.

About the Consultants

The Delphi Group (delphi.ca) produced the quantitative research data and analysis at the core of this report. The Delphi Group is a Canadian strategic consultancy providing innovative solutions in climate change and corporate sustainability. As a pioneer in sustainability and environmental risk management, The Delphi Group has more than 30 years of experience helping some of Canada's best-known companies improve the sustainability of their organizations – as well as the local and global communities in which they operate.

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Executive Summary

This report serves as the definitive account of the impacts of – and opportunities offered by – Canada's green building industry today and in the coming critical decade. It quantifies the industry's growth and significant and far-reaching economic, environmental, and social contributions. It also outlines how a COVID-19 pandemic recovery plan centred on green buildings could create almost 1.5 million jobs all across Canada by 2030 while helping to ensure our nation meets its climate targets. Finally, this report spotlights key market trends and drivers that are already enabling and accelerating the country's shift to high efficiency, zero-emissions buildings, and examines how each could impact Canada's green building industry.

For a 90-second video summary of this report's top findings, please visit: **CaGBC.org/greenrecovery**

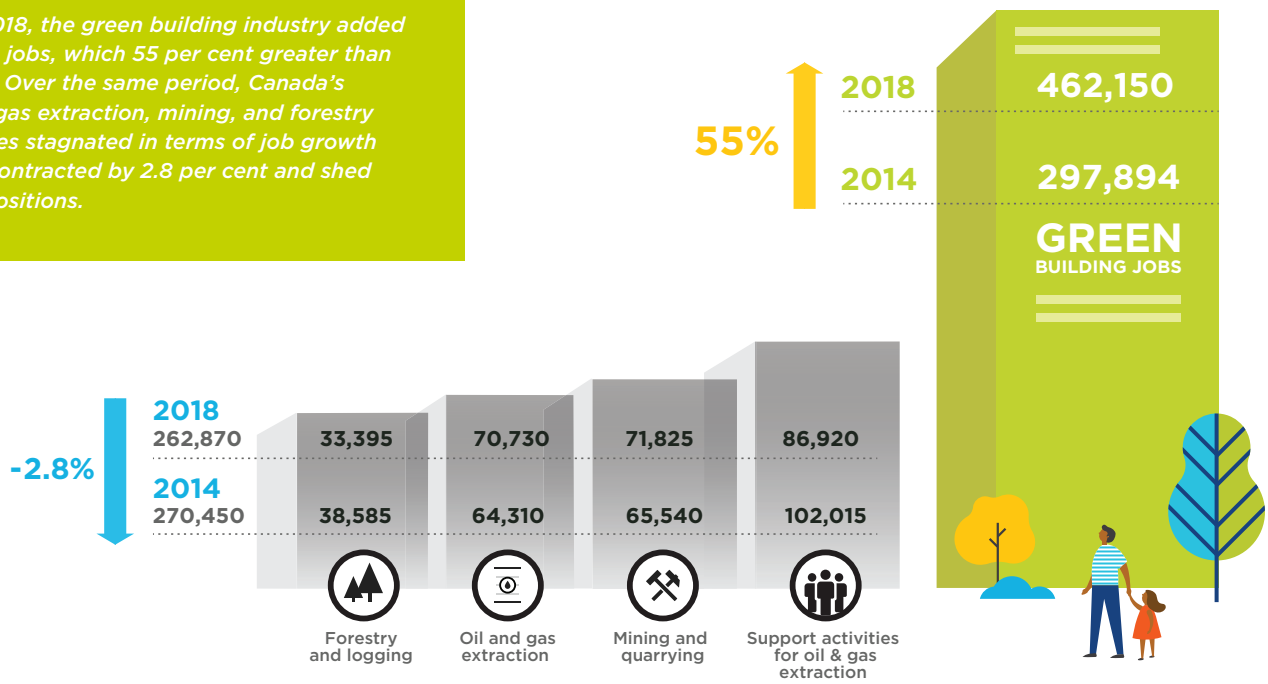
Canada's Green Building Sector Today

Since the first edition of this market assessment was produced four years ago, Canada's green building industry has grown and matured into a significant economic force.

As of 2018, the most recent year for which complete data is available, the industry employed 462,150 direct full-time workers. That number is substantially higher than job counts in the natural-resource sectors that many have long considered pillars of the economy. For example, the green building sector employs almost 200,000 more Canadians than the oil and gas extraction, mining, and forestry sectors combined.

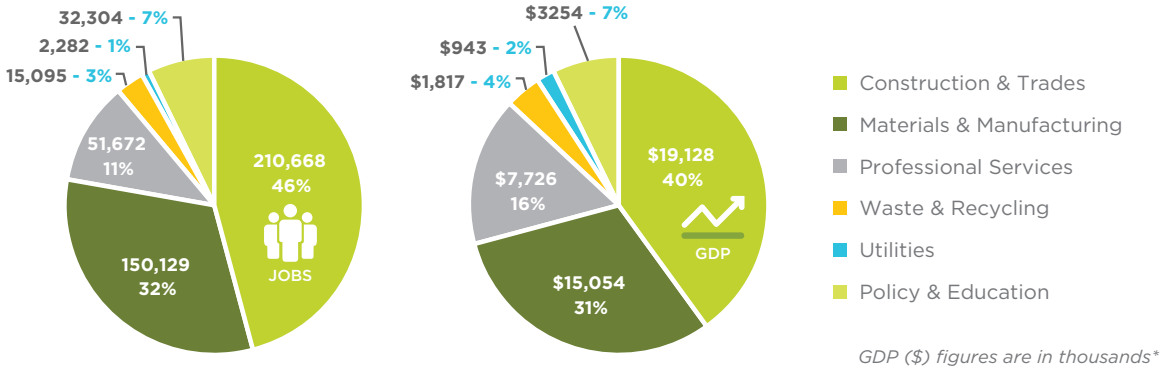
Figure 1: Canadian Green Building Job Growth Compared to Other Key Industries

As of 2018, the green building industry added 164,260 jobs, which 55 per cent greater than in 2014. Over the same period, Canada's oil and gas extraction, mining, and forestry industries stagnated in terms of job growth – they contracted by 2.8 per cent and shed 7,580 positions.



While total job counts have grown across most industries, reflecting growth in the overall economy and labour force over that time period, the percentage of a given industry devoted to green building activity has soared. We attribute this to improved building codes, increased market penetration and adoption of energy-efficient products and materials, and to the somewhat recent sharp increase in awareness of the causes and impacts of climate change.

Figure 2: Green Building Jobs and GDP by Sector (2018)



On a dollars and cents basis, the green building industry more than doubled between 2014 and 2018, growing from $23.4 billion to approximately $47.9 billion in gross domestic product. Though every province and territory is reaping the benefits of green building, in descending order, Ontario, Quebec, and British Columbia employ the most green-building workers, and the green building sectors in those provinces contribute more to provincial GDP than their peers.

Ontario leads the nation in the green building industry's economic contribution, with 227,938 direct green building industry jobs and a $22.7 billion direct contribution to GDP. Quebec follows, with 74,754 direct green building jobs and a $7.5 billion direct GDP contribution. British Columbia rounds out the top three with 71,914 direct jobs and $8 billion GDP.

We attribute variations in green building economic activity between provinces to the amount of investment and green-building certification activity as a percent of total construction activity in those jurisdictions. Provinces with more progressive building codes and municipal bylaws show a higher overall level of green building economic activity.

New construction remains almost 80 per cent of all green building activity. However, existing buildings represent a critical growth opportunity for the industry. The increasingly urgent climate challenge will drive this work; according to Natural Resources Canada and Environment and Climate Change Canada, Canada has approximately 2.9 billion square metres[1] of largely inefficient building and homes that contribute 17 per cent to the nation's overall greenhouse gas (GHG) emissions,[2] but closer to 30 per cent when construction and materials are considered.[3]

1 Natural Resources Canada. "Residential Housing Stock and Floor Space." Retrieved from https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=HB&sector=res&juris=00&rn=11&page=0#sources and "Commercial/Institutional Energy Prices and Background Indicators." Retrieved from https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=HB&sector=com&juris=00&rn=7&page=0#sources

2 Environment and Climate Change Canada (2016). "Pan-Canadian Framework on Clean Growth and Climate Change: Canada's Plan to Address Climate Change and Grow the Economy," p. 14.

3 United Nations Environment Programme (2019). 2019 Global Status Report for Buildings and Construction: Towards a Zero-Emission, Efficient and Resilient Buildings and Construction Sector, p. 9.

As of 2018, green retrofits yielded only one in five jobs in green building construction and trades, or 45,053 positions. To prosper in the coming critical decade while meeting the climate challenge, Canada will need to develop a strong retrofit economy – a prosperous ecosystem of private, public, and non-governmental actors.

Role of Certifications and Building Codes

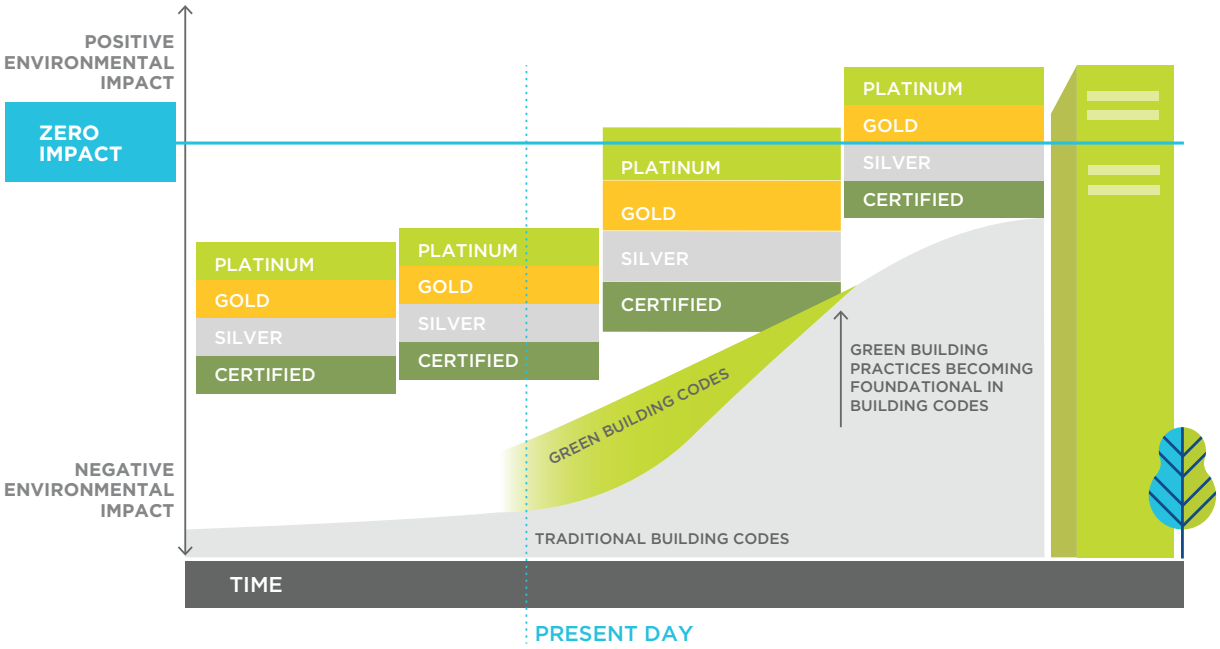
Green building certification programs are not only growing increasingly stringent, but also broadening in scope. Over the past decade, they have raised the bar on energy efficiency, renewable energy, and sustainability practices. By extension, they have changed the way Canadians design, construct, maintain, and operate buildings.

Third-party certifications also play a quality-assurance role because the bodies that oversee these certifications are, by definition, independent of a project team, and can spot issues in construction documentation that others may overlook.

Canadians have grown conscious of a broader range of social and environmental challenges. This shift, and resulting public pressure, have in turn, spurred policy-makers and industry leaders to raise the bar on sustainability – leading to increased government activity and higher standards for both building codes and industry certifications. Both mandatory and voluntary green building programs have proliferated across the country and are increasingly becoming mainstream industry standards and practices, especially in Class A commercial buildings.

Voluntary certifications have demonstrated what is possible, and given governments the confidence to embrace higher levels of regulation. They will continue to push the envelope of possibility.

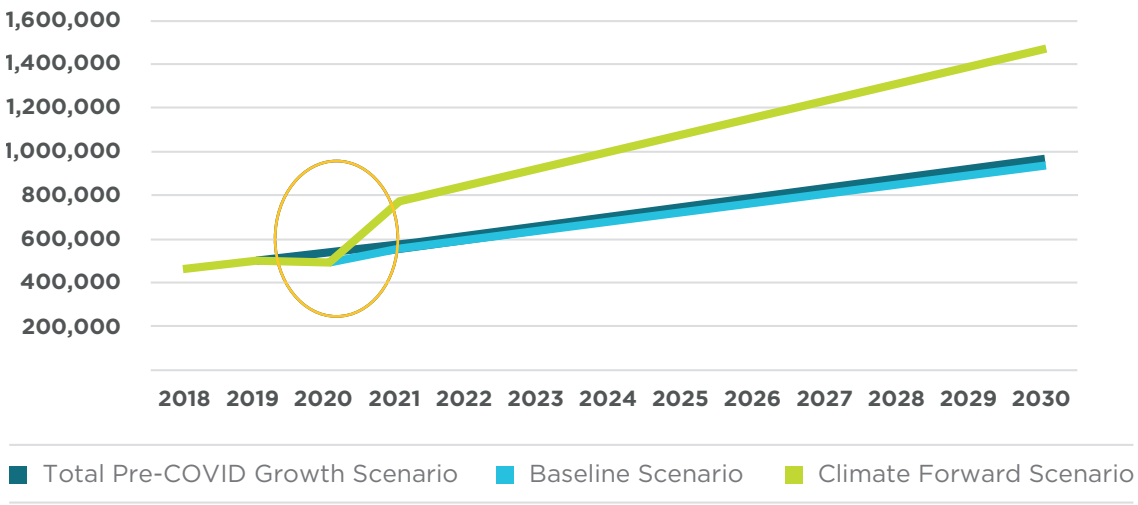
Figure 3: Impact of Green Building Certification and Building Codes over Time



The Critical Decade

CaGBC commissioned the scenario modelling work underpinning this report to gain fresh insights into the size and growth of Canada's green building industry. However, the onset of the COVID-19 pandemic – and the prospect of potentially unprecedented public stimulus investments – spurred a revisit and a broadening of the scope of inquiry. The following scenarios were eventually arrived at:

Figure 4: Green Building Job Growth (2018-2030)



Pre-COVID-19 Scenario

This scenario is based on economic and industry growth projections as of January 2020, considering existing and announced climate strategies, targets, and building code updates. Assumptions include that provinces and local governments will continue to implement their plans to move to zero carbon construction practices and green building retrofits.

Baseline Scenario

This scenario considers existing and announced climate strategies, targets, and building code updates, but adjusts them for the impacts of COVID-19 and the subsequent oil price collapse. It assumes that the movement toward zero carbon construction and green building retrofits slows to some degree in certain provinces.

Climate Forward Scenario

This scenario assumes governments adopt a green-building-focused recovery program that serves to both reboot the economy while ensuring Canada meets its 2030 climate target. It includes accelerated investments in net zero carbon new construction and increased investment into green building retrofits. It also assumes governments focus any future pandemic response stimulus packages on green building while making significant investments in climate mitigation and adaptation.

Figure 5: Impact of the Climate Forward Scenario

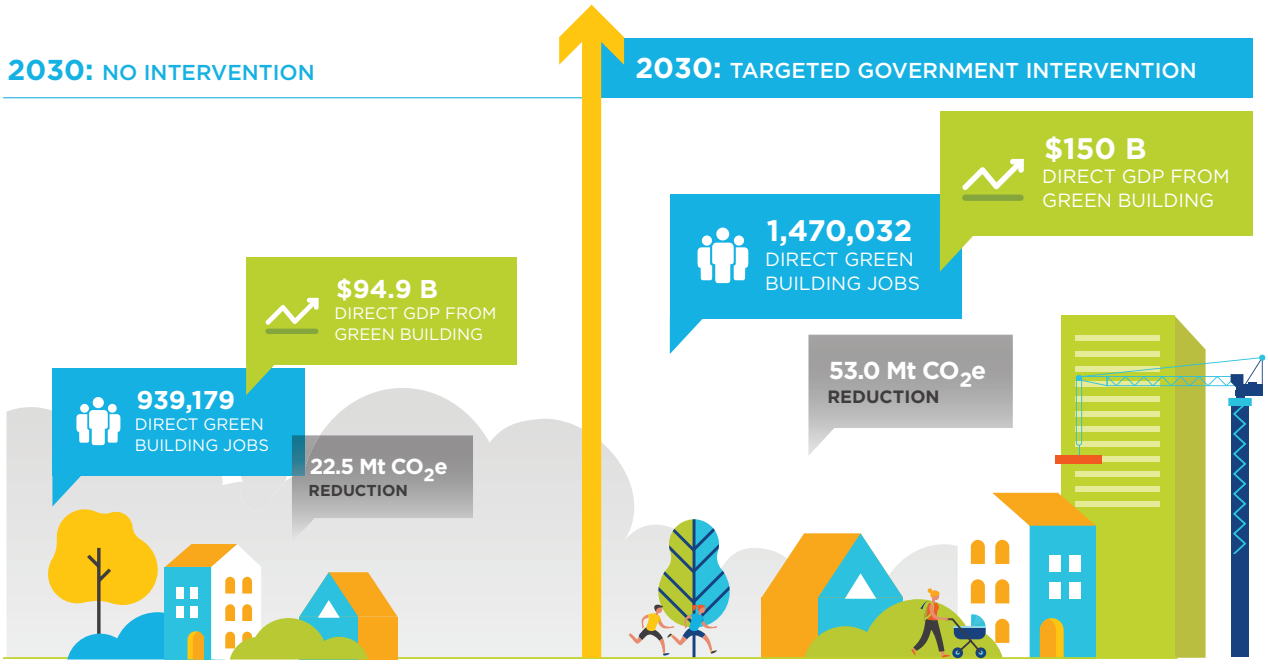


Figure 6: Green Building GDP and Job Growth (2030)

The results demonstrate that the sector can and must play a leading role in this critical decade for climate action. Without targeted government intervention, by 2030, Canada can expect 939,179 direct jobs in green building, a reduction of 22.5 megatonnes of carbon-dioxide equivalent (Mt CO_2e) that year compared with 2018 levels, and $94.9 billion in direct GDP from green building investments.

In contrast, under the Climate Forward scenario, by 2030, Canada could expect 1,470,032 direct jobs in green building and a 53 Mt CO_2e reduction compared with 2018 levels. The green building industry would also contribute $150 billion in direct GDP.

Should governments take targeted action to support green building efforts and directly link stimulus spending to climate change mitigation and adaptation, they would lead the country to a green

recovery. That approach would both revitalize the economy and ensure we meet our 2030 climate target. Canada's construction and infrastructure development sectors will be at the forefront of the low-carbon transition, as the sectors represent more than seven per cent of our GDP and almost 30 per cent of our GHG emissions when operations, construction and materials are considered.

To ensure Canada is prepared for the future with a strong economy that benefits everyone, new funding allocations must provide a sustainable benefit for diverse, future generations. Prioritizing public investment in green buildings will help alleviate the nation's economic burden while decreasing unemployment rates. Developing a comprehensive investment pipeline of shovel-worthy projects will maximize the opportunity. Shovel-worthy projects will also provide a positive return on investment and ensure a speedy and safe recovery.

A green recovery would lead to 530,853 more direct green building jobs in 2030 and an additional $55 billion in direct GDP. It would also avert the release of over 30 Mt CO_2e by 2030 when compared with 2018. By making smart investments in the green building sector today, the federal government could help meet its 2030 climate target while adding more than $100 billion in direct GDP to the economy over and above 2018 levels.

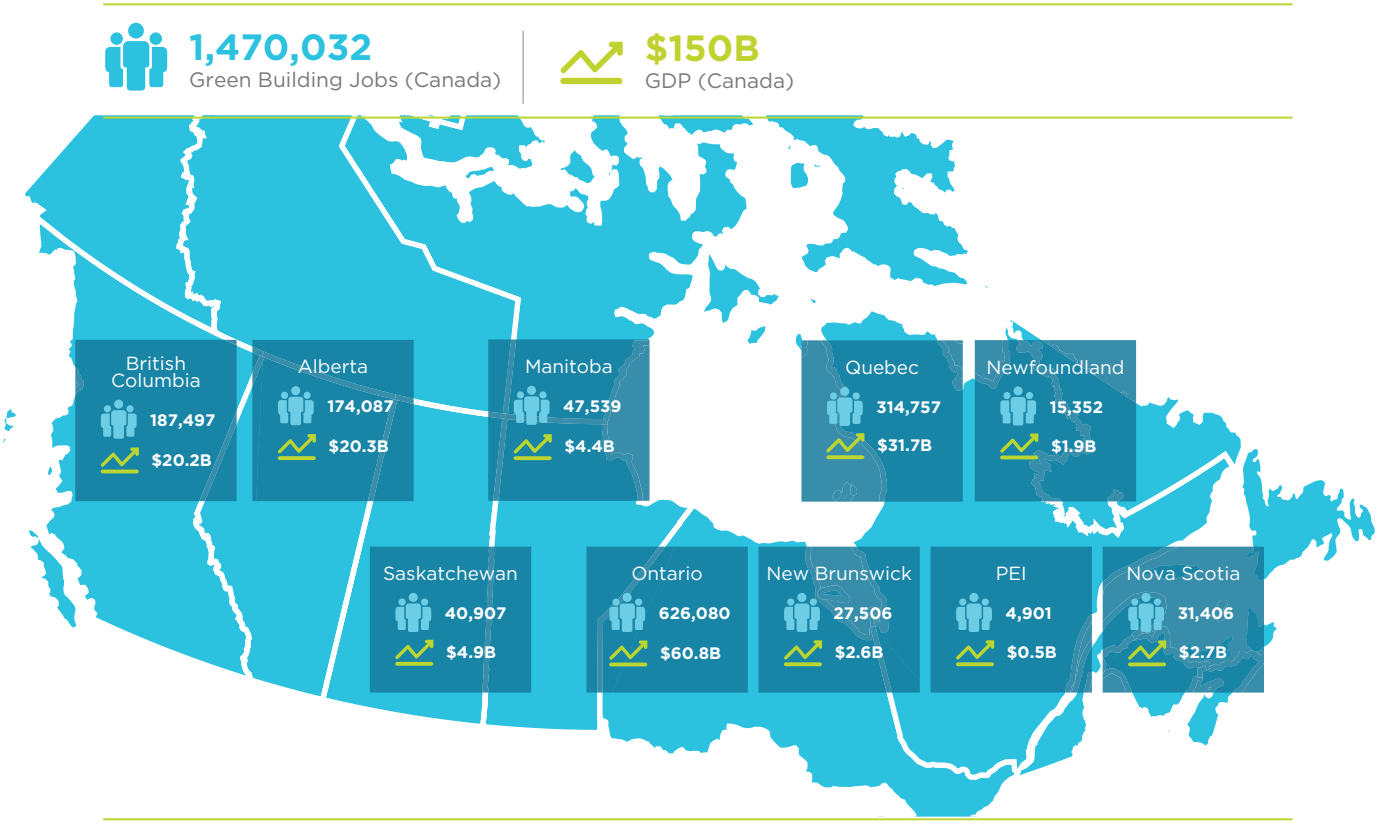
Status Quo and Outlook for Green Building Jobs and GDP

The green building industry is active in all provinces and territories. In our modelling, Ontario and British Columbia (both at around three per cent) show the greatest share of green building jobs as a percentage of total employment across the economy – as well as the highest percentage of green activity within construction and trades. In Ontario, 23 per cent of construction jobs are green-building related; in British Columbia the corresponding figure is 19 per cent. Overall, 17 per cent of Canada's construction jobs in 2018 were green building related, which equals 210,668 construction jobs.

It is expected that the percentage of green building construction jobs to total construction jobs will grow dramatically in all provinces between 2020 and 2030. Nationwide, growth is expected from 17 per cent to 57 per cent.

Companies active in green building **Construction and Trades** account for the largest percentage (46 per cent) of Canada's green building employment – close to one fifth – of Canada's total construction workforce. Green building business activity in Construction and Trades contributes about $19.13 billion dollars, or about 40 per cent, of total green-building GDP.

Figure 7: 2030 Direct Green Building Jobs and GDP by Province in the Climate Forward Scenario



Leading Trends and Drivers

A number of trends and drivers are accelerating and informing the shift to high-performance green buildings in Canada. They include:

Climate Change: Green buildings will play a leading role in both reducing GHG emissions and responding to the new challenges of a warmer world. Builders and developers will look to new technologies and strategies to reduce the energy required to build their projects. Canada's buildings will also play a role in responding to the impacts of climate change. Buildings will need to keep cool through summer heatwaves, protect their occupants from extreme wind and rain, and be hardened against potential structural damage from soil subsidence.

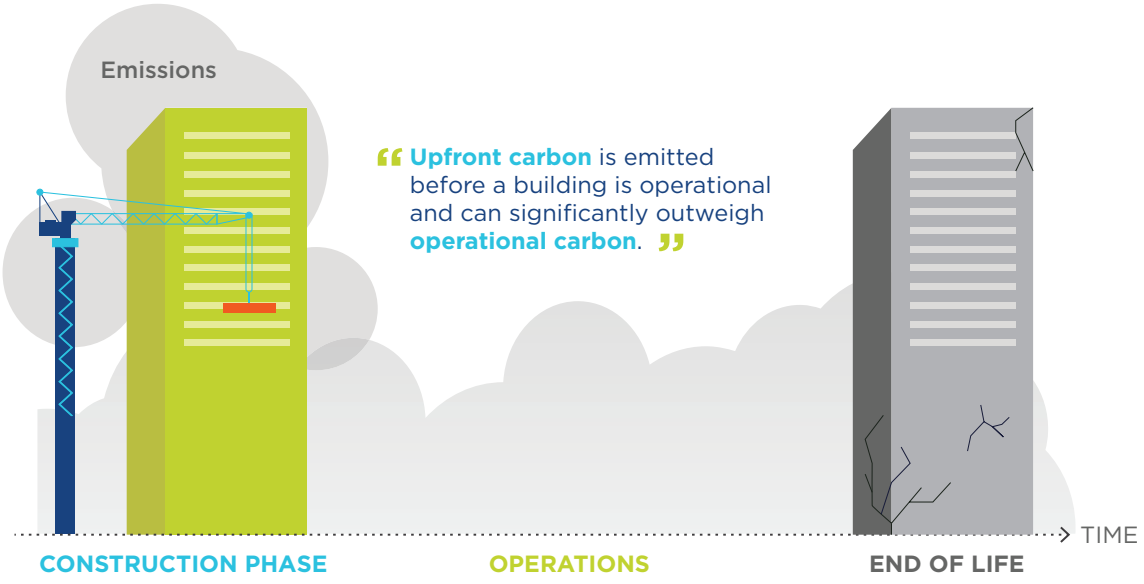
The Circular Economy: The "take-make-dispose" economic model is fundamentally at odds with a low- to zero carbon energy and material efficient society. Circular economy advocates support a model that designs out waste and pollution, keeps products and materials in circulation, and regenerates natural systems.

Healthy, Equal, and Inclusive Buildings: Green buildings can deliver social sustainability and physical and mental health benefits. They either reduce or eliminate a range of indoor pollutants and contaminants and encourage better physical and mental health. In the coming years, we expect green buildings will more consistently and reliably support diversity, equity, inclusion, and justice to truly welcome everyone.

The Retrofit Economy: The process and practice of retrofitting existing buildings offers the building sector a cost-effective opportunity to meet its GHG targets. Governments should establish the appropriate market infrastructure to create a self-sustaining retrofit economy that would yield industry-trusted standards, methodologies, and certifications, as well as access to financing.

Embodied Carbon and Sustainable Materials: Embodied carbon emissions arise from the manufacture, transport, installation, use, and end-of-life processing of the materials that collectively constitute a building. Calculations of a given material's embodied carbon typically considers the carbon intensity of its manufacturing process, the modes and distances by which it is transported to the job site, and the processes by which it is constructed, maintained, and ultimately removed and handled at the end of the building's life.

Figure 8: Impact of Upfront and Operational Carbon Emissions



Digitization and Smart Buildings: Digitally controlled mechanical and electrical systems will grow both more sophisticated and more intuitive to use in the years ahead. Building automation helps improve occupant comfort, ensure efficient building systems are performing as expected, and can reduce energy consumption and operating costs. These technologies will also give building operators the tools and information they'll need to make smarter choices.

Energy Storage and Resiliency: Energy storage not only smooths out the inherent variability of wind and solar generation, it serves as a backup energy supply in the event of a severe storm or extremely hot or cold weather. Thermal energy storage allows excess thermal energy to be accessed hours, days, or even months after it is produced. As for chemical storage, lithium ion batteries are becoming increasingly accessible and available to the building industry thanks to an innovation push from the electric car industry.

Opportunities to Build a New Economy – Call to Action

In summary, Canada's green building industry is creating healthier and more comfortable places to work, live, learn, and play. It is also creating opportunity. The green building industry today contributes approximately $48 billion in GDP to Canada's economy. It directly employs almost twice as many full-time workers as the country's oil and gas extraction, mining, and forestry sectors combined. However, despite significant improvements in building codes and policies, as well as the strong market uptake of LEED® and similar certification programs, green building still has a long way to go to become mainstream.

A large percentage of Canada's buildings continue to be constructed without green building practices or third-party certification. Building codes and municipal bylaws in provinces such as British Columbia are driving market transformation via new construction. Still, the existing building market remains the most significant untapped opportunity for economic development, job creation, and GHG reductions.

The building sector can lead the way through a green recovery by creating skilled jobs and driving innovation that will grow the low-carbon economy within the coming years, yielding significant emissions reductions and job creation as part of the economic recovery. Investments in green building can be a key driver of the COVID-19 pandemic recovery and could provide a return on investment that would uniquely benefit Canadians.

Green building investment would create a great deal of good in this country: Skilled job creation, an increase in low-carbon innovation, and buildings and homes that are healthier, less expensive to operate, and more resilient and responsive to our shared environmental and climate change challenges.

If you support this vision, please join the growing chorus of green building professionals who are calling for a green recovery focused on green buildings, via **CaGBC.org/greenrecovery**

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Introduction and Context

For many years, Canada's political and economic establishment undervalued the nation's green building industry and instead focused on resource extraction and energy supply.

However, as the need for bold climate action has grown increasingly apparent, investors, consumers, and governments have begun shifting priorities. Canada's green building sector is now widely understood as both a steady driver of gross domestic production (GDP) and a leading solution to the most significant challenge of our age. It is this country's next large industry, as important, if not more so, than aerospace, banking, or oil and gas.

The evidence of climate change is all around us. The Intergovernmental Panel on Climate Change agrees that limiting global warming to 1.5°C demands "rapid and far-reaching transitions" that are "unprecedented in terms of scale."[4] The World Economic Forum directly connects seven of its top 10 global risks to climate.[5] Moreover, the Task Force on Climate-related Financial Disclosures points to the "real and already present risks" that the phenomenon poses for businesses and financial markets, and warns of serious and long-term consequences for companies that fail to act, adapt, and disclose carbon risk.[6] Investors are demanding action, which is driving exponential growth in green finance. Worldwide, investors now hold at least USD $44 trillion in sustainable investments, up 34 per cent from 2016.[7]

While extensive research has addressed the environmental benefits of green buildings, the sector's broader economic contribution has received considerably less attention, particularly in Canada. This report aims to address that shortfall. It quantifies the economic impact of green buildings in this country, showcases the impressive market transformation underway, and demonstrates its potential future contributions.

Buildings offer one of the largest energy and greenhouse gas (GHG) emission reduction opportunities. Worldwide, the built environment generates 39 per cent of all climate pollution.[8] The business case is crystal-clear: Global evidence confirms that green buildings deliver extensive

4 Intergovernmental Panel on Climate Change. Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments. 2018.

5 World Economic Forum. The Global Risks Report. 2019.

6 Taskforce for Financial Related Climate Disclosures. Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures. 2017.

7 Global Sustainable Investment Alliance. 2018 Global Sustainable Investment Review. 2019.

8 International Energy Agency Global Alliance for Buildings and Construction. 2018 Global Status Report. 2018.

benefits, including lower operating costs and higher returns, enhanced productivity, faster patient recovery times, and improved learning outcomes, among others. They reduce stress on power grids, support a low-cost pathway to a carbon-positive built environment, and improve household and business resilience.[9]

Canada's green building industry will help drive the nation's low-carbon transition and will help ensure it meets its GHG targets. New construction projects must incorporate design elements that will achieve zero carbon emissions, and existing buildings need to include deep emission reduction targets in their retrofit plans. Buildings currently contribute 17 per cent of Canada's carbon emissions.[10] Globally, when construction and materials are included in that calculation, they contribute a further 11 per cent.[11] Should the industry fail to change its practices, experts expect that number will increase by another nine per cent over the next two decades.[12]

Canada's green building industry has an advanced understanding of how low-carbon technologies can be used to design and construct high-performance buildings. It now has close to two decades of experience working with third-party rating systems such as LEED® and BOMA BEST®, and implementing code improvements and corporate policies.

However, new green building construction alone will be insufficient to deliver on Canada's 2030 GHG emission reduction target. CaGBC research confirms that national targets can only be reached by also reducing the emissions from the billions of square feet of existing institutional, commercial, and residential spaces across the country. While builders and developers are increasingly adopting green-building approaches, building owners and managers are not yet broadly retrofitting existing properties. Both will be needed to drive energy and GHG reductions at the needed scope, scale, and speed.

Last year, the World Green Building Council – the global network of national green building councils – set a target for all building construction and operations to eliminate GHG emissions entirely by 2050.[13] Existing CaGBC research demonstrates the potential for significant reductions. Canada can slash building sector GHG emissions 17 per cent below 2005 levels by constructing all new large buildings to zero carbon standards between 2017 and 2030.[14] The industry could capture a further 51 per cent reduction by retrofitting existing buildings to zero carbon standards.[15]

To accomplish these reductions, the industry must move away from merely concentrating on energy-efficiency measures and instead embrace a more integrated approach.[16] Such an approach should encourage energy efficiency while reducing both the carbon intensity of a building's energy sources and the carbon footprint of its construction materials.

9 Australian Sustainable Built Environment Council and ClimateWorks Australia. "Built to Perform: An Industry Led Pathway to a Zero Carbon Ready Building Code." 2018.

10 Environment and Climate Change Canada. Pan-Canadian Framework on Clean Growth and Climate Change: Canada's Plan to Address Climate Change and Grow the Economy. 2016.

11 Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme. 2019 Global Status Report for Buildings and Construction: Towards a zero-emission, efficient and resilient buildings and construction sector.

12 National Energy Board. Canada's Energy Future. 2017.

13 World Green Building Council. Bringing Embodied Carbon Upfront. 2019.

14 Canada Green Building Council. Building solutions to climate change. How green buildings can help meet Canada's 2030 emission targets. 2019.

15 Canada Green Building Council. Roadmap to Retrofits. 2017.

16 Construction for high-performance buildings is the practice of designing, constructing, operating, maintaining, and deconstructing buildings in ways that conserve natural resources and limit greenhouse gas emissions.

The green building sector has evolved over the past two decades in response to policy changes, market demand, and environmental concerns. In Canada, green buildings are already measurably reducing energy use and GHG emissions. While builders and developers once voluntarily adopted green building measures, governments are increasingly rolling out regulations intended to advance market transformation. While primarily motivated by climate change and economics, those governments also recognize the growing body of evidence that green buildings deliver resilience, equity, health, and wellness co-benefits.

At the same time, Canada's green building industry has become fiercely competitive, raising the bar on performance. Companies leading building design, construction, and operation, and their partners across the value chain, embrace green building as a standard of practice. Green buildings are pushing new solutions and driving innovation in service delivery and processes, product and technology design, manufacturing, and material and resource use. Designers, product developers, businesses, and owners are undertaking continuous environmental and economic improvements and adopting a holistic approach to building design and development.

In short, the green building sector's economic impact is significant and will continue to grow as green becomes the standard of practice across Canada.

This report makes the case that green building is now an established Canadian industry. It begins by outlining several possible development pathway scenarios, focusing on a Climate Forward scenario. It then offers provincial and territorial breakdowns of the economic data, beginning with a comparison and ranking, followed by a detailed description of the status of the industry in each province and territory. The report then turns to the current trends and innovations that will drive the industry forward, and assess how government investment could maximize the value captured along the way.

Introduction and Context

Defining Green Buildings and Jobs

What is a green building?[17]

A green building is any new or existing building that is designed, constructed and/or renovated and operated to achieve clearly defined environmental and other sustainable objectives that are measurably above code, often adhering to industry standards (e.g., LEED®), stepped or tiered codes, and green building policies. Further, a new or existing green building typically has one or more of the following attributes:

- Reduced GHG emissions from building construction and operation
- Efficient use of energy, water and other resources
- Use of renewable energy, such as solar energy
- Pollution and waste reduction measures, and the enabling of re-use and recycling
- Excellent indoor air quality
- Use of non-toxic, ethical, and sustainable materials
- Consideration of occupant quality of life in design, construction, and operation
- Adaptable to a changing environment
- Consideration for additional environmental outcomes.

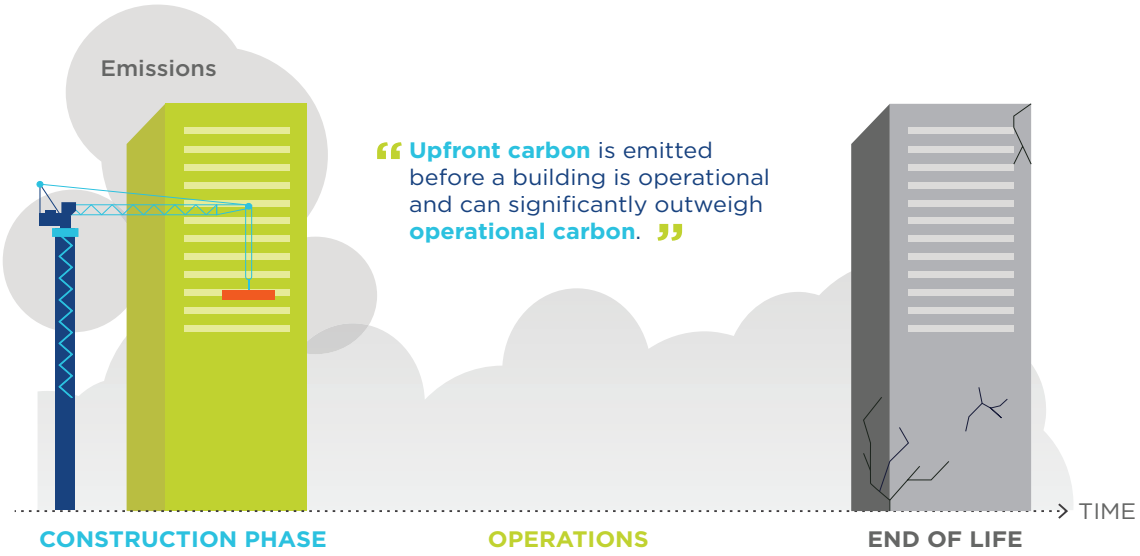
Any new and existing building can be a green building, whether it is a home, office, school, hospital, community center, or any other type of structure, provided it embraces these attributes. However, not all green buildings are – nor need be – alike. Geographical regions vary in climatic conditions, building types and ages, and/or environmental, economic, and social priorities. All of these considerations inform a given jurisdiction's approach to green building.[18]

Canadians are already enjoying the benefits of green construction and design every day, in their schools, homes, offices, and elsewhere. They are enjoying healthy indoor air because green buildings are well-ventilated and furnished without toxic materials. They are enjoying brighter spaces, due to abundant daylight, and healthier active living, due to interior design and location selection. They are enjoying quiet and comfort, thanks to increased insulation and improved temperature control. For all of the above reasons, those who work, learn, and play in green buildings enjoy increased productivity and performance. Meanwhile, their employers and instructors enjoy improved employee retention, fewer sick days logged and improved learning outcomes.

17 For a detailed methodology, see Appendix 1. For a list of the NAICS codes used in this research, see Appendix 2.

18 World Green Building Council. "What is green building?" Retrieved from: https://worldgbc.org/what-green-building.

Figure 9: Impact of Upfront and Operational Carbon Emissions



For this report, green construction projects are defined as those that meet one or more of the following criteria:

- A certification system with documented and verified increased performance level, specifically LEED®, Zero Carbon Building Standard, BOMA BEST®, BuiltGreen®, or Novoclimat;
- An energy rating standard, such as ASHRAE 90.1, ASHRAE 100, Passive House, EnerGuide 80, ENERGY STAR®, R-2000; and/or
- Evidence of exemplary equivalent performance as demonstrated by other means in energy efficiency, water efficiency, and/or materials or resource efficiency, including through building code or municipal bylaw minimum standards.

The outcomes from the different rating systems vary greatly, depending on certification level, performance thresholds, overall rigour, and the operation and maintenance of the resulting building.

What is a green building job?

Think of a green job as one devoted to activities that restore or preserve environmental quality, reduce energy, materials, and water consumption, decarbonize the economy, and minimize or avoid waste and pollution.[19] In a narrower sense, a green building job focuses on the design, construction, operation, or evaluation of green buildings. The definition also includes positions in green building education, advocacy, promotion, or regulation, and those associated with the manufacturing, marketing, and distribution of green building products and services.

19 United Nations Environment Programme. 2008. Green Jobs: Towards Decent Work in a Sustainable Low Carbon World. Retrieved from: https://sustainabledevelopment.un.org.

Green building occupations, professions, and skills

Many likely associate green jobs with highly specialized science and engineering professions, or with those who invent cutting-edge technologies to mitigate climate change and pollution. While building science and engineering specialists indeed play a central role in creating green buildings, green jobs – and green building jobs in particular – are far more diverse. They include those who design, build, or even deconstruct green buildings. Green building workers include architects and designers, researchers, educators, those who recover and process valuable resources, and policy-makers who create regulations and the local or provincial government staffers who oversee them.[20]

Demand for green building expertise has spurred new jobs, occupations, and subsectors. These jobs are found in areas such as energy modeling, green roof design and construction, and sustainability consulting. Other green building jobs exist within "traditional" realms, including the construction trades, equipment manufacturing, architecture, and engineering. Property managers are increasingly incorporating "green literacy" skills in their work, as building owners improve carbon, energy, and resource efficiency.[21] People working in the green building industry typically represent a small fraction of those employed in their sector, and activities dedicated to green buildings may only constitute a given percentage of their work description. Thus, either a certain percentage of jobs in a given sector could be considered – or a certain portion of an individual's job – to be green.

The green building industry encompasses a diversity of sectors that in turn occupy a wide range of occupations. These include specialized occupations such as energy modeller and installers of renewable energy technologies, but also insulators, electricians, architects, software developers, and office assistants.

Despite the green building sector's size, Statistics Canada does not identify nor track it, presenting a challenge for those monitoring its growth. In an effort to capture the broad spectrum of the industry, this report assesses subsectors, not occupations. This means that in defining a green building job, we considered the nature of a given business, rather than the nature of a given occupation.

The green building industry encompasses a diversity of sectors that in turn occupy a wide range of occupations. These include specialized occupations such as energy modeller and installers of renewable energy technologies, but also insulators, electricians, architects, software developers, and office assistants. We include or exclude a job in the green building industry based on the sector it "belongs to" and the degree to which the employer in question involves itself in green construction projects.

To estimate the number of green building jobs in Canada, we established percentages (or "intensity ratios") of green building activity for each sector, along the full green building value chain in each province and territory. This remains a moving target. For some subsectors, the percentage is quite

20 Vancouver Economic Commission. "State of Vancouver's Green Economy 2018." Retrieved from: https://vancouvereconomic.com/research/state-of-vancouvers-green-economy-2018.

21 For a definition of green literacy skills, as well as common skills gaps in the industry, please refer to these CaGBC reports: "Trading Up: Equipping Ontario Trades with the Skills of the Future" (2019) and "Accelerating to Zero: Upskilling for Engineers, Architects, and Renewable Energy Specialists" (2020). Both are available via cagbc.org.

large, whereas in others, such as policy and education, or the utilities, the percentages are quite small – and vary widely across the country. Sector categories cover the entire value chain of green building activity: Construction and Trades, Materials and Manufacturing, Professional Services, Policy and Education, Waste and Recycling, Utilities (see below). Sectors include architecture, design, engineering, residential and industrial, commercial, and institutional (ICI) building suppliers, operations, and related supporting organizations.

To identify the sectors and subsectors participating in Canada's green building industry, we turned to the North American Industry Classification System (NAICS).[22] Since the NAICS does not yet identify or classify green building industries, we manually created a set for this report by reviewing the system's 2,064 codes. This list appears in Appendix 2.[23]

Figure 10: The Green Building Industry in Canada

22 The statistical agencies of Canada, Mexico and the United States developed the North American v Classification System to provide common definitions of the industrial structure of the three countries and a common statistical framework to facilitate the analysis of their economies.

23 We estimated the percentage of green building activity within each industry for the North American Industry Classification System (NAICS) codes that make up Canada's full green building sector value chain at the three- to four-digit level, by province and territory, through the development of "intensity ratios" that we applied to each NAICS code. Details on the methodology can be found in Appendix 1, a list of the NAICS codes in Appendix 2.

PART A
Canada's Green Building Industry Today

In this section we outline how Canada's green building industry is stimulating new investments and driving job creation and revenue across the full construction value chain and project life-cycle. We detail the industry's growth since we first took stock in the 2016 version of this report,[24] and estimate its current economic contributions as represented in jobs and gross domestic product (GDP) overall and as broken down into sectors.

We also delineate green building economic activity by new construction and retrofits, and explain the industry's role in laying the groundwork for improved green building codes, policies, regulations, and certifications.

Employment and Gross Domestic Product

A variety of drivers have spurred employment, investment, and economic activity across Canada's green building construction value chain. These include industry leadership, the growth of certification programs, public sector policies, building code advancements, and institutional sector sustainability commitments. In this section, we quantify the industry's employment and gross domestic product.

We estimate that **Canada's green building industry employs 462,150 direct full-time workers and generates approximately $47.9 billion in gross domestic product (GDP).**

As of 2018, Canada's green building industry employs more people than several of the natural-resource industries that economists have long regarded as our nation's fundamental sectors. The green building industry represents almost 200,000 more jobs than Canada's oil and gas extraction, mining, and forestry industries – plus jobs supporting activities for oil and gas extraction and mining. Taken together, these resource industries collectively employed approximately 262,870 workers in 2018.

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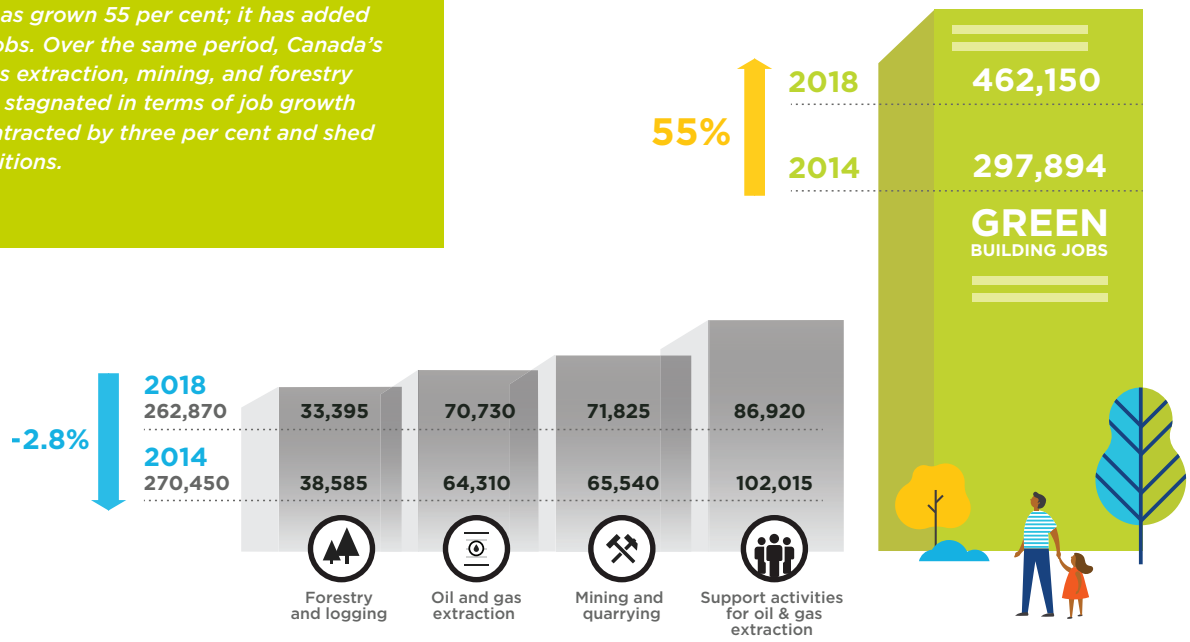
24 The 2016 Market Impact Report is based on data from 2014. This report is based on data up to the end of 2018. For a detailed methodology, see Appendix 1.

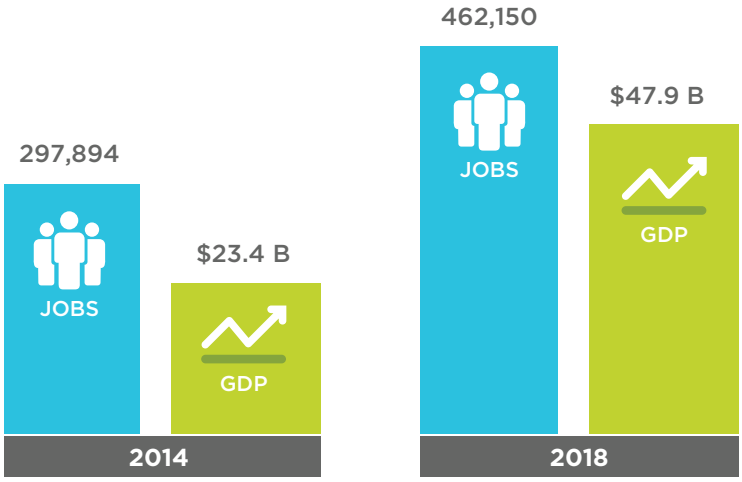
Figure 11: Canadian Green Building Job Growth Compared with Other Key Industries

Since 2014, employment in the green building industry has grown 55 per cent; it has added 164,260 jobs. Over the same period, Canada's oil and gas extraction, mining, and forestry industries stagnated in terms of job growth – they contracted by three per cent and shed 7,580 positions.



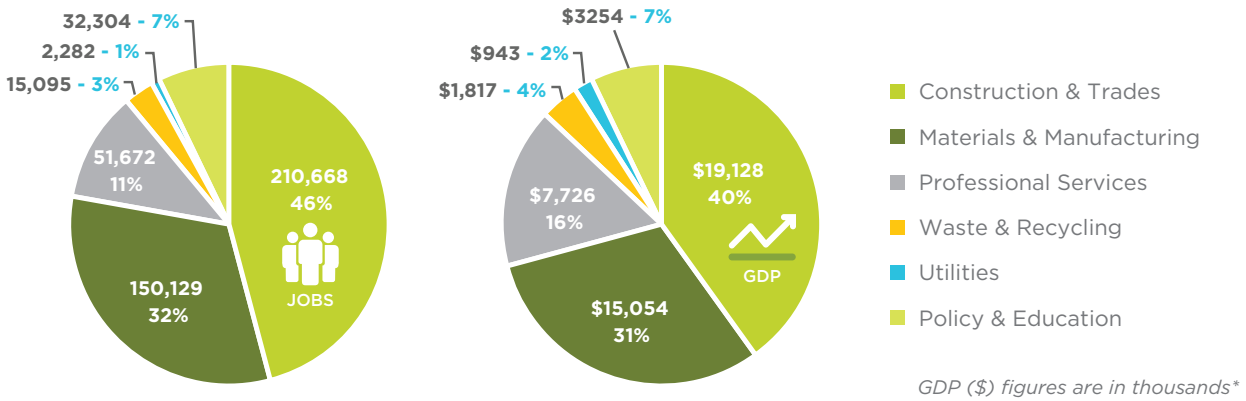
In 2018, the green building industry employed 164,260, which is 55 per cent greater than in 2014. Over the same period, Canada's oil and gas extraction, mining, and forestry industries contracted by three per cent while shedding 7,580 jobs.

Figure 12: Growth of the Green Building Sector



With respect to both jobs and GDP, Canada's green building sector has grown substantially since 2014. Of course, total job counts have grown across most industries, reflecting growth in the overall economy and labour force over that time period. But, critically for this report, intensity ratios – that is, the percentage of a given industry devoted to green building activity – have risen substantially across a number of industries and provinces. We attribute this to improved building codes, increased market penetration and adoption of energy efficient products and materials, and the somewhat recent sharp increase in awareness of the causes and impacts of climate change that compel us to radically reduce our GHG emissions.

Figure 13: Green Building Jobs & GDP by Subsector (2018)



Companies active in green building **Construction and Trades** account for the largest percentage (46 per cent) of Canada's green building employment, equal to approximately 210,668 jobs. Green building construction jobs represent about 17 per cent – close to one fifth – of Canada's total construction work force. Green building business activity in Construction and Trades contributes about $19.1 billion dollars, or about 40 per cent, of total green-building GDP. Jobs in this sector include positions constructing, renovating or deconstructing new and existing non-residential and residential buildings targeting certification under a recognized green building standard or certification, or high performance buildings where required by code.

Since 2014, the green building industry has grown by 55 per cent while Canada's oil and gas extraction, mining, and forestry industries have contracted by three per cent and shed 7,580 jobs.

Materials and Manufacturing includes firms that produce green construction materials, wood-based products, and energy-efficient building equipment and technologies linked to market penetration of ENERGY STAR® and other efficient building equipment and lighting. This sector accounted for 32 per cent of all green building employment and 31 per cent of green-building GDP – a six per cent increase in the relative market share of green building and GDP since 2014. This pencils out to approximately 150,129 jobs and about $15 billion in green building industry GDP in 2018 – an almost tripling of green building GDP share and a near doubling of jobs.

Professional Services encompasses firms active in green building design, architecture, engineering, property management, and related scientific and technical services. In 2018, these companies collectively generated approximately 51,672 jobs and $7.7 billion in GDP.

The **Policy and Education** sector employed approximately 32,304 people in green building. This includes jobs in universities, colleges, and technical trade schools, industry associations and non-profit organizations, as well as government agencies.

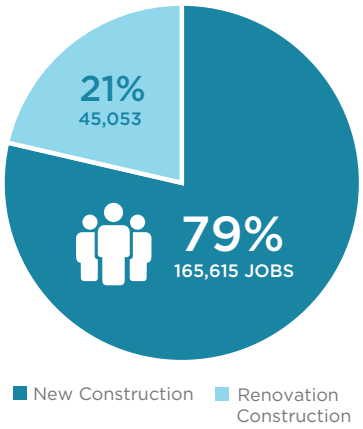
Waste Management and Recycling employed approximately 15,095 green-building-related workers in Canada in 2018. This sector includes those who collect and treat construction waste and recyclable materials.

We attribute 2,282 direct green building jobs to **Utilities**. This includes employees that work on demand-side management programs as well as financing and rebates for performance upgrades. Together, they generated $943 million in GDP in 2018.

New Construction and the Green Renovation Market

New construction forms the backbone of Canada's green building industry, and always has. Today, it constitutes close to 80 per cent of all green construction. We see this reflected in the percentage of jobs dedicated to new buildings versus renovation.

Figure 14: Jobs in Green Building Construction and Trades (2018)



A new building today will be an existing building tomorrow, which is why those starting a new project must commit to low- or zero-carbon performance. Every new building that is not designed for a carbon-constrained future only adds to our retrofit challenge down the road, and will inevitably require major investments in its mechanical equipment, ventilation system, and building envelope to meet our GHG targets. These retrofits would need to occur before the normal span of life-cycle re-investments, which will prove costly and disruptive to building owners, operators, and tenants.

According to Natural Resources Canada and Environment and Climate Change Canada, there are about 2.9 billion square meters of largely inefficient buildings and homes that currently contribute 17 per cent of the nation's carbon emissions, and closer to 30 per cent when construction and materials are considered;[25] while the construction of new, highly efficient green buildings will be an important pillar of the green building sector's contribution to GDP, jobs, and emission reductions, the existing building stock remains Canada's biggest challenge and opportunity.

The vast majority of Canada's buildings will still be operating in 2030. When well executed, green

25 Torrie, Ralph and Bak, Celine. "Building Back Better With a Green Renovation Wave." Corporate Knights. April 22, 2020.

retrofits offer significantly reduced energy consumption and emissions, lower operating costs, and increased property values. Retrofits also improve conditions for occupants by creating healthier indoor environments, and help develop new expertise within the real estate sector while generating attractive returns for lenders and investors.[26]

Programs such as LEED® and BOMA BEST® are helping drive commercial office retrofits. Some leading commercial real estate owners have undertaken whole-building energy retrofits for their properties. In addition, provincial codes, municipal bylaws, and various incentive programs are emphasizing the retrofit opportunity for existing buildings. Demand-side management programs and product rebates run through and by provincial utilities have further improved market uptake.

Despite these scattered successes, with respect to employment, green retrofits lag far behind new construction. As of 2018, retrofits yielded only one in five jobs in green building Construction and Trades, or 45,053 positions.

A surge of retrofits will not only help Canada reach its GHG targets, it will also create new jobs. To create that surge, Canada will need to develop a strong retrofit economy – an ecosystem of private, public, and non-governmental actors who both collaborate and compete. It will take leadership from all sides and a serious commitment to make it real.

The Role of Codes, Policies, Regulations, and Certifications

Buildings create a myriad of environmental impacts across their full life-cycle, from the first shovelful of earth turned in construction to the removal of their last remnants decades later. During construction, occupancy, renovation, repurposing, and demolition, buildings consume energy, water, and raw materials, and generate waste as well as air and climate pollution. Growing recognition of these impacts decades ago spurred the creation of voluntary green building industry certifications. Following a wave of environmental initiatives in the 1970s, green buildings were first formally and comprehensively defined by voluntary certifications in the 1990s, with the U.S. Green Building Council unveiling LEED® in 2000. (Canada's counterpart followed three years later.) Other industry-led certifications subsequently emerged, including Green Globes and BOMA BEST® in 2005. Germany's Passive House standard reached Canadian shores in 2013.

These certifications sought to inspire and applaud leadership within the building industry by outpacing building codes, as government regulations and policies did not support leadership in sustainability at the time. Industry associations and non-government organizations developed these third-party voluntary programs to clarify the core characteristics of green buildings and move the industry forward towards innovation and higher standards by demonstrating what was possible.

Over the past decade, green building certification programs have raised the bar on energy efficiency, renewable energy, and sustainability practices. Along the way they have changed the way we design, construct, maintain, and operate buildings. The number of buildings and homes in Canada rated by

26 Canada Green Building Council. "Building Solutions to Climate Change: How Green Buildings Can Help Meet Canada's 2030 Emissions Targets" (2016), "Roadmap to Retrofits in Canada" (2017), and "Roadmap to Retrofits II: Building Strong Market Infrastructure for the Retrofit Economy" (2018). All available via cagbc.org.

these certification standards has been growing continuously.[27]

Third-party certifications also play a quality-assurance role. The bodies that oversee these certifications are by definition independent of a project team. For example, in many instances the LEED® certification process has uncovered errors in a given project's building energy models. With errors identified, design teams have had opportunities to tweak their systems and ensure that the completed project performs as intended. Third-party certification data can help project proponents, local governments, and building owners measure progress towards their sustainability goals.

As market demand for green buildings heats up, and as developers and municipalities compete for leadership, some may be tempted to greenwash or pursue a "shadow" certification.[28] Without the critical oversight of a legitimate third-party verification, parties will have no way of knowing that such a building performs as designed.

Public demand has helped push for healthier buildings that provide good ventilation and air quality, and that are also affordable. The COVID-19 pandemic underscored the critical role of buildings in public health and community resilience.

Until recently, at least in the commercial real estate sector, building owners, institutional investors and other industry leaders largely drove the growth of green buildings. But with increasing societal awareness of climate change and other environmental issues, sustainable construction practices have merged into the mainstream. Canadians are conscious of a broader range of social and environmental challenges, and are increasingly connecting the dots between, for example, waste and hazardous chemicals and substances, and the buildings within which they live, work, play, and learn. As a result, certification programs are not only growing increasingly stringent, but broadening in scope.

This shift and public pressure has in turn spurred policy makers and industry leaders to raise the bar on sustainability, leading to increased government activity and higher standards for both building codes and industry certifications. Public demand has helped push for healthier buildings that provide good ventilation and air quality, and that are also affordable. The COVID-19 pandemic underscored the critical role of buildings in public health and community resilience.

Provincial and Local Government Green Building Leadership

Provincial and local governments (as addressed in Part C) have begun defining their own green building standards and policies, including "beyond code" initiatives that regulate energy and water regulations for new construction. During the 2000s, governments began aligning their building codes with the requirements of green-building certifications.

Initially, governments almost exclusively drove the shift toward green building practices in Canada via policies that sought to green and certify public buildings. In doing so, they helped build industry capacity and seed the market. National and provincial government regulation and policies, such as

27 For a descriptions of these third-party standards and certifications, see Cipriani, V. and Behan, K. Clean Air Partnership. March 2020. pp. 40-46. Retrieved from: https://cleanairpartnership.org.

28 Vierra, Stephanie. "Green Building Standards and Certification Systems." Whole Building Design Guide. August 2019. Retrieved from: https://wbdg.org/resources/green-building-standards-and-certification-systems

building codes and benchmarking regulations, have begun moving towards more energy-efficient, performance-based models, thus raising the bottom line.

With respect to climate change, one of the most powerful tools local governments have is their authority over local planning decisions, including their ability to approve new construction projects and major renovation projects. By implementing green development standards, local governments can create a low carbon building stock. Canada's existing building stock must be retrofitted in order to meet the country's climate targets, and several jurisdictions are currently developing policies to do so. A national retrofit code is also in the works.[29]

With two exceptions noted below, Canada's local governments generally cannot create and modify their own building codes. However, many can establish green development standards.[30] By applying such standards over time, communities can gradually reduce operational and embodied climate pollution.

A growing complement of local governments are introducing or strengthening green-building regulations and policies. The City of Toronto introduced its Toronto Green Standard in 2006 and, as of mid-2020, is applying Version 3 to all new developments.[31] Similarly, in 2017 the city developed its Zero Emissions Building Framework, with energy targets set to achieve zero emissions by 2050.

Along similar lines, the City of Vancouver – which, like Toronto, has its own building code – is steadily implementing its Zero Emissions Building Plan. That policy will require the majority of the city's new buildings to have no operational greenhouse gas emissions by 2030.[32] Vancouver also has regulations that require builders to, for example, divert construction waste from landfills, and reclaim a portion of wood from older homes as they are being dismantled for redevelopment.

In 2017, the Province of British Columbia made the BC Energy Step Code available to local governments that wished to use it. The regulation allows a jurisdiction with authority to enforce the BC Building Code to incentivize or require builders or developers to deliver a level of energy performance that goes above and beyond the base code's minimum requirements. As local governments "climb the steps" and increase those requirements over time, industry will steadily boost its capacity to deliver higher performing buildings. British Columbia has also signaled that it will align upcoming code revisions with the BC Energy Step code in 2022 and 2027. Nova Scotia is also considering a similar tiered building energy code.

29 Ibid.

30 Ibid

31 Ibid.

32 "Zero Emissions Building Plan," City of Vancouver. Retrieved from https://vancouver.ca/green-vancouver/zero-emissions-buildings.aspx.

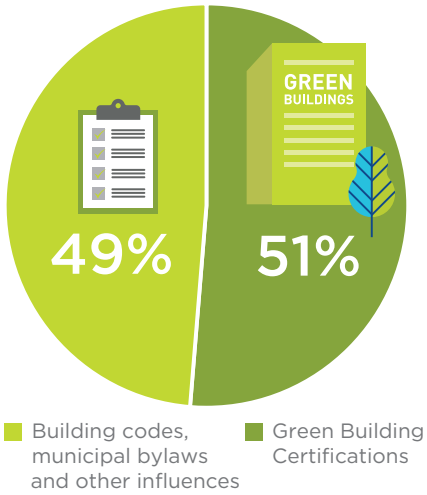
Voluntary Green Building Leadership

Simultaneously, voluntary green building programs have proliferated across the country and are increasingly becoming mainstream industry standard and practice, especially in Class A commercial buildings.[33] In response to rising tenant and investor demand for green office space, industry leaders are developing large commercial office, mixed-use, and high-rise residential developments to meet green building certifications.

Our assessment of Canada's leading green certification programs suggests that non-residential developers and builders participate in such programs far more than their residential counterparts.[34] Depending on the province, non-residential projects constitute up to 78 per cent of green building certifications. In Alberta, non-residential projects constitute 72 per cent of all green building activity. Nationally, non-residential projects earn just over half (52 per cent) of Canada's green building certifications but are only one third (28 per cent) of overall construction. Meanwhile, just four per cent of projects in Canada's residential sector are certified.[35]

This estimate aligns with the findings of the International Green Building Adoption Index (IGBAI), a 2018 joint initiative of commercial real estate and investment firm CBRE Group and Maastricht University in The Netherlands.[36]

Figure 15: Influence of Green Building Certifications on Non-residential Green Building Activity



The Index identifies a significant uptick in voluntary green building certifications in major metropolitan office markets across the globe. About 19 per cent of non-residential floor space is now certified green in 10 markets across Australia, Canada, and Europe, the researchers report – up from six per cent in 2007. Canadian cities set the pace, with 52 per cent of non-residential space in Vancouver and 51 per cent in Toronto under certification. Green building trends continue to drive both new development and redevelopment of offices in both of those cities. In Vancouver, more than half of the 1.5 million square feet of office product currently under development is being built to high green certification standards, while much of Toronto's existing Class A product is undergoing intensive capital improvement projects that include

33 NAACP (National Association for the Advancement of Colored People). Getting Beyond Green: A baseline of equity approaches in sustainable building standards. July 2019. Retrieved from: https://naacp.org/wp-content/uploads/2020/04/CESBS-Equity-Baseline-for-Building-Standards_July-2019.pdf

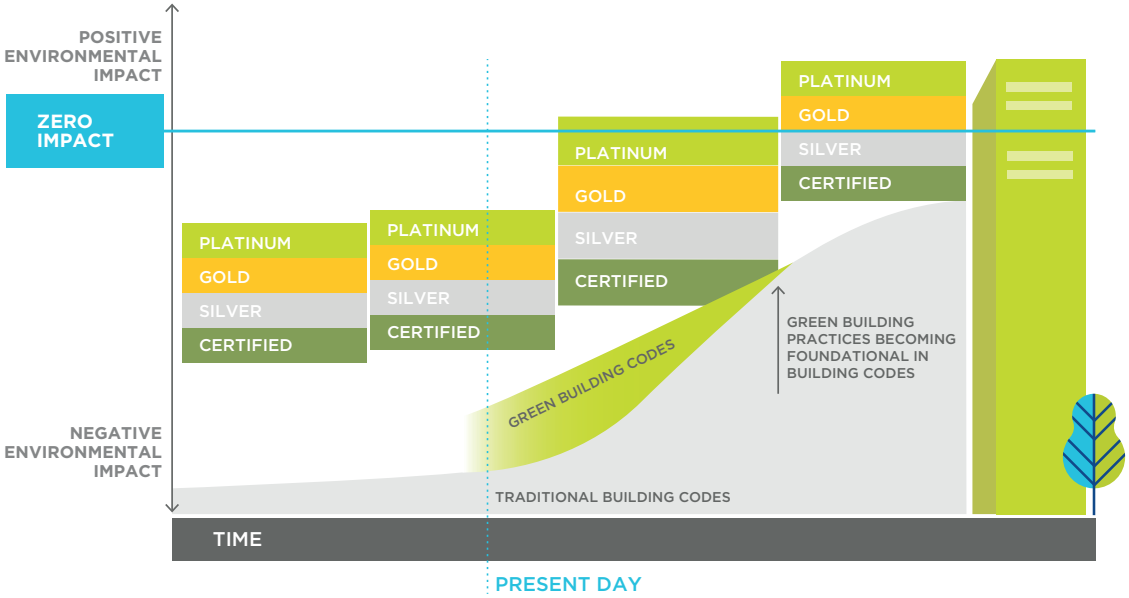
34 We included the following certifications in this assessment: LEED®, Zero Carbon Building Standard®, BOMA BEST®, BUILT GREEN®, Novoclimat, Passive House, ENERGY STAR®, and R-2000.

35 Other influences that show exemplary equivalent performance by other means in the areas of energy efficiency, water efficiency, material or resource efficiency, including through building code or municipal bylaw minimum standards.

36 CBRE Group and Maastricht University. International Green Building Adoption Index 2018. Retrieved from: https://cbre.com/about/media-center/green-building-certifications-on-the-rise-in-major-international-markets

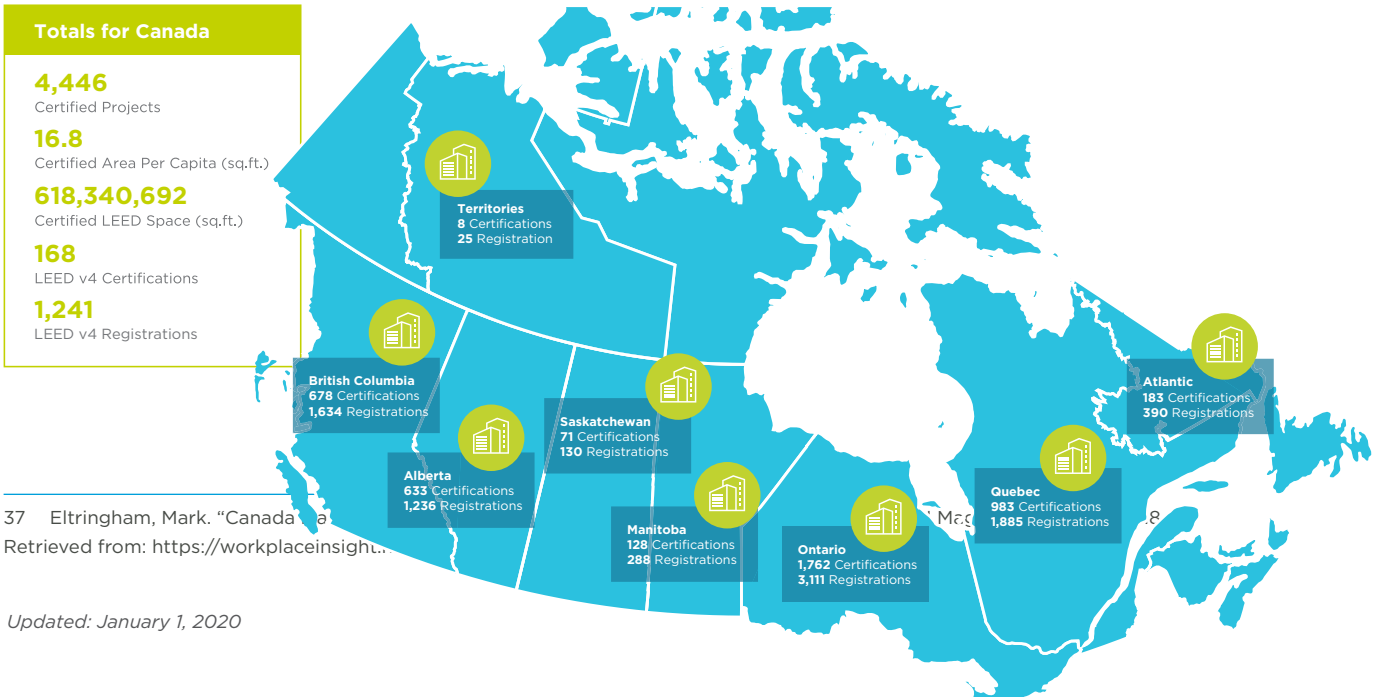
upgrades targeting green certifications.[37]

Figure 16: Impact of Green Building Certifications and Building Codes Over Time



Certifications have proven foundational in establishing and sustaining Canada's green building industry. They have demonstrated what is possible, giving governments confidence to embrace higher levels of regulation. Stepped or tiered codes allow jurisdictions to move more quickly, and further, by providing industry with a roadmap and schedule of steadily increasing requirements. It is no accident that stepped or tiered building energy codes mimic the performance thresholds defined by many standards (e.g. certified, silver, gold, and platinum). As the industry moves forward, voluntary certifications will continue to define green buildings and push the envelope of possibility.

Figure 17: LEED Adoption in Canada



37 Eltringham, Mark. "Canada [illegible] Mag[illegible]8
Retrieved from: https://workplaceinsight[illegible]

Updated: January 1, 2020

PART B

Growth Scenarios for Canada's Green Building Industry

In this section we outline the role that the green building industry could play in helping Canada recover from the COVID-19 pandemic while meeting its climate targets. We apply three Modelled scenarios to understand prospective responses, explain the concept of shovel-worthy green building projects, and demonstrate how such projects can deliver both economic growth and climate benefits.

Our Modelling Scenarios

Economic Modelling can offer decision makers valuable insights into the direction of any industry by revealing the likely impact of various policies and investments. When we began the modelling work underpinning this report in early 2020, we sought to gain fresh insights into the size and growth of Canada's green building industry by considering existing and announced climate strategies, targets, and building code updates.

However, the advent of the COVID-19 crisis – and the prospect of potentially unprecedented public investments to reboot the economy – subsequently spurred us to revisit and broaden our scope of enquiry. We eventually arrived at the following scenarios.[38]

1. **Pre-COVID-19 Scenario**: We base this scenario on economic and industry growth projections as of January 2020, considering existing and announced climate strategies, targets, and building code updates. The scenario assumes provinces and local governments will continue to implement plans to move to zero-carbon construction practices and green building retrofits.
2. **Baseline Scenario**: We base this scenario on economic and industry growth projections, considering existing and announced climate strategies, targets, and building code updates – but adjust them for the impacts of COVID-19 and the subsequent oil price collapse. We also assume the movement toward zero-carbon construction and green building retrofits slows to some degree in certain provinces. Finally, we also assume that by 2030 approximately 20 per cent of all retrofit activity is green building related, and that 65 per cent of total construction activity in Canada is retrofit related. Further, we assume governments do not target green building retrofit projects for fiscal stimulus as part of their pandemic recovery spending.

38 The three scenarios include economic projections from 2018 to 2030 for jobs associated with the value chain and sectors that represent the green construction industry in Canada and its provinces as defined earlier in this report. We base the projections on average or blended growth rates from leading consultancies, banks, and Employment and Social Development Canada (ESDC). We do not intend for the scenarios to be interpreted as forecasts. We have modeled Canada's 10 provinces, but not its territories. For additional methodology details, see Appendix 1. Regarding limitations: Forecasting always has an element of uncertainty and can only apply defensible and reasonable assumptions to information available at any given time. We based the report on information available in spring 2020, when the duration and severity of the COVID-19 pandemic remained unclear.

3. **Climate Forward Scenario**: This scenario assumes federal and provincial governments adopt a green-building-focused green recovery stimulus program that reboots the economy while ensuring the nation meets its 2030 climate target. It includes increased investments in net zero carbon new construction and increased investment into green building retrofits to more closely align with zero carbon construction goals overall. The scenario also assumes that governments will focus future pandemic response stimulus packages on green building, while making significant investments in climate mitigation and adaptation. Finally, it assumes that by 2030, 30 per cent of all retrofits will be green and low carbon, and approximately 90 per cent of all new construction across the country will be net zero carbon.

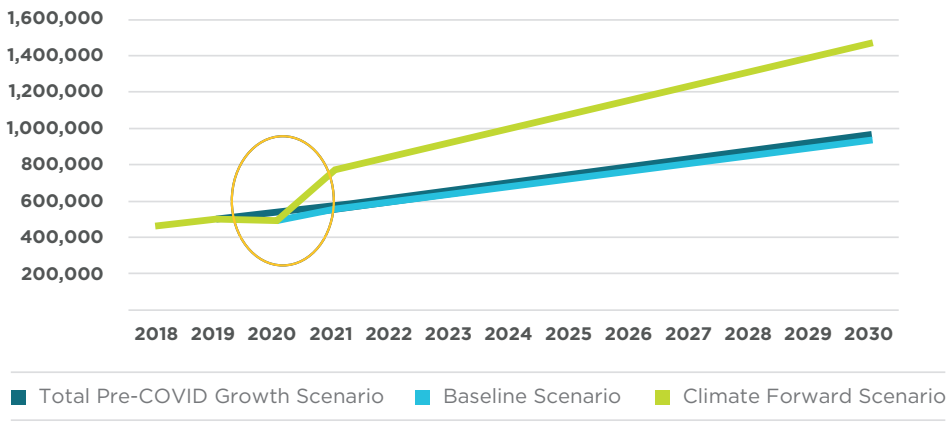
The Case for a Green Recovery

The COVID-19 pandemic has profoundly disrupted Canadian lives and livelihoods. For the building industry, the different intensities of outbreaks across the country prompted varying degrees of construction shutdowns. While provinces such as Quebec and Ontario either stopped construction in part or completely, British Columbia and other jurisdictions allowed work to continue under new health and safety rules. The pandemic also impacted the permit process and the work of consultant teams.

Given the economic slowdown, commercial developers and residential homebuilders are now likely exceptionally cost-sensitive. This challenges the industry to redouble its efforts to communicate the importance of rigorous green building standards. The crisis also offers Canada's governments a unique opportunity to shape the future direction of not only the construction sector but the economy at large.

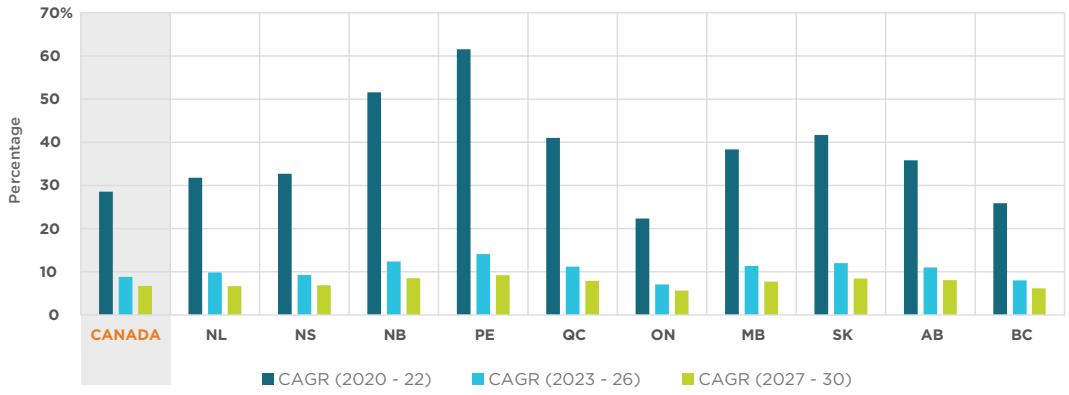
Should governments take targeted action to support green building efforts and directly link stimulus spending to climate change mitigation and adaptation, they will lead the country to a green recovery. Not only would such an approach reboot the economy, it would help ensure our nation meets its 2030 climate target. Canada's construction and infrastructure development sectors will be at the forefront of the low-carbon transition, as the sectors represent more than seven per cent of our GDP and almost 30 per cent of our GHG emissions.[39]

Figure 18: Green Building Job Growth under 3 scenarios (2018-2030)



39 Providing we include building operations, construction, and materials.

Figure 19: Growth Rate of Green Building Jobs Under Climate Forward Scenario



The scenarios we modelled for this report offer unparalleled insights into the opportunity on offer and the consequences of not pursuing it.

In the Pre-COVID-19 scenario, the green building industry grows 6.3 per cent each year on average, between 2018 and 2030 – accumulating 963,329 jobs in 2030 when compared with 2018.

If we consider the impacts of the pandemic, but without a corresponding green recovery effort – our Baseline scenario – the national annual growth rate remains at a more modest 6.1 per cent between 2018 and 2030, reaching 939,179 jobs in 2030. In this scenario, we would expect to see a tick-shaped green building industry growth projection (also known as a "Nike-swoosh" recovery) for this year and the next. If we base our assumptions on the overall economic employment projections across all sectors, green building jobs will stay below the original pre-pandemic level from 2022 onwards.

The scenarios we modelled for this report offer unparalleled insights into the opportunity on offer and the consequences of not pursuing it.

Then there is our Climate Forward scenario. Under this scenario, governments concentrate stimulus spending on the green building industry. Owing to the pause of the overall construction sector (including green building) in 2020, this scenario shows a decrease in employment numbers, followed by a rapid recovery in late 2020 or 2021 – supported, in turn, by an increase in green building caused by investment combined with progressive policy leadership.

Should governments pursue the Climate Forward scenario, the green building industry would not only help ensure Canada meets its 2030 GHG target, but it would also provide 1,470,032 jobs by that year – more than triple the green building industry's 461,265 jobs in 2018.[40] This would yield an annual average growth rate of 10 per cent between 2018 and 2030 and a GDP of $150 billion – compared with the $94.9 billion that the economy would see without any green recovery measures.

40 For statistical reasons, the forecast does not include the territories.

Under the Climate Forward scenario Canada would reduce GHG emissions 51 per cent in 2030 compared with 2018, a decline of 53 Mt CO_2e equivalent. Without that concerted effort, those reductions would be 22.5 Mt CO_2e – less than half of the potential.

Further, a green recovery would lead to 530,853 more direct green building jobs in 2030, $55 billion and then 30 MT more in direct GDP, and GHG reductions of 30.47 Mt CO_2e by 2030, when compared with 2018.

IN SUMMARY

Without **targeted government intervention, by 2030 Canada could expect:**

- 939,179 direct jobs in green building;
- 22.5 Mt CO_2e reduction in 2030 compared with 2018 levels; and
- $94.9 billion in direct GDP from green building.

And *with* the targeted government intervention we detail in our Climate Forward scenario, by 2030 Canada could expect:

- 1,470,032 direct jobs in green building;
- 53 Mt CO_2e reduction in 2030 compared with 2018 levels; and
- $149.9 billion in direct GDP from green building.

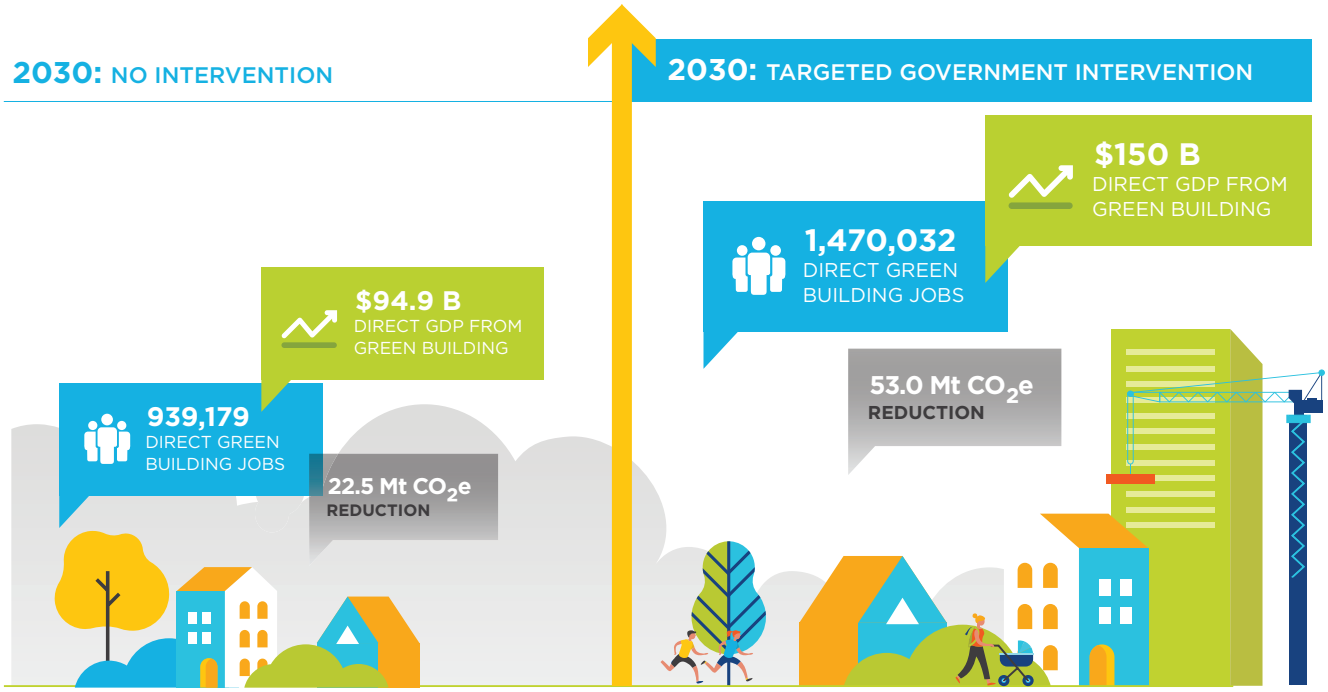


Figure 20: Comparison of Green Building GDP And Job Growth (2018 and 2030)

The prospective gains are impressive. However, Canada will only achieve them if governments include low-carbon new construction and retrofits in their COVID-19 recovery plans. Should they elect to focus on other priorities, they will only capture a modest percentage of these benefits.

Ensuring Thoughtful Funding Allocations

Sectors eligible to participate in an economic stimulus program will need to be in a position to deliver "shovel-worthy" projects.[41] These are projects that could get underway quickly, and that also advance additional goals, such as emissions reductions.[42] The construction sector is the obvious focus of a stimulus plan, because it currently provides a livelihood for 6.5 per cent of all employed Canadians; note that 17 per cent of these jobs currently meet our criteria for "green" but we estimate that by 2030 57 per cent could be green.

The green building industry was responsible for 2.5 per cent of Canada's employment overall in 2018. It provides a wide spectrum of jobs, including positions for unskilled workers needing low-barrier employment. It is also a domestic industry; a significant proportion of the supply chain – think concrete, windows, plumbing materials, and metal cladding – are either produced in Canada, or easily could be.

Canada will only achieve the gains if governments include low-carbon new construction and retrofits in their COVID-19 recovery plans. Should they elect to focus on other priorities, they will only capture a modest percentage of these benefits.

Governments can help alleviate the nation's economic burden while decreasing unemployment rates by prioritizing public investment in green buildings. A first step would be to develop an investment pipeline of projects that are not only shovel-ready, but shovel-worthy.

41 A shovel-ready project is one in which planning, costing, and necessary engineering studies have advanced to the stage where work can begin within a given near-term time period, ranging between 90 and 180 days. In contrast, a shovel-worthy project is a product of sound, meaningful, and effective long-term planning, and that enhances quality of life and benefits the economy and environment, while delivering a positive return on investment.

42 Wherry, Aaron. "Environmentalists want stimulus funds to focus on 'shovel-worthy' sustainable projects." CBC News. May 19, 2020. Retrieved from: https://cbc.ca/news/politics/wherry-green-economy-recovery-1.5574533

Our Climate Forward data demonstrates that shovel-worthy green building projects can deliver both economic growth and climate benefits. As governments assess the great number of prospective stimulus projects, they may wish to keep in mind evaluation criteria such as:

- Jobs created per dollar invested, and the extent to which those jobs are secure and in sunrise industries;
- The long-term economic impact of projects that boost Canadian innovation and competitiveness, drive domestic supply chains, and mobilize private investment; and,
- The capacity of a project to encourage cleaner energy and energy efficiency and support the country's climate targets.[43]

Among other measures, meeting this objective will require that all new buildings larger than 25,000 square feet meet zero carbon standards. This is roughly the equivalent of 47,500 new residential units and 4,800 new commercial and/or institutional zero carbon buildings annually.[44]

Canada's Climate Action Imperative

To avoid the worst effects of climate change and meet its Paris Agreement commitment, Canada must drastically ramp up its efforts to reduce carbon pollution.

Our nation committed to reduce GHG emissions 30 per cent below 2005 levels by 2030.[45] As of 2005, the federal government estimated total emissions at 730 Mt CO_2e. To fulfil our commitment to the global community, we must drive them down to 511 Mt CO_2e by 2030. In other words, we must reduce climate pollution 304 Mt CO_2e from our starting point. Environment and Climate Change Canada expects buildings will contribute 47 Mt CO_2e to that reduction.[46]

However, despite numerous programs and policies, including a back-stop national carbon price, as of the end of 2018 Canada had only achieved 0.4 per cent of its 2030 target. The federal government will need to find nearly 22 megatonnes of GHG reductions, each year, for each of the coming 10 years, to hit its target and ultimately achieve net-zero emissions by 2050.

In 2018, climate pollution increased across the economy, with the exception of electricity production, which has been trending down since the early 2000s. Unfortunately, building-sector emissions have grown faster than all other sectors, and are now at 13 per cent of all emissions. Environment and Climate Change Canada attributes this to colder winter weather, which boosts heating demand and thus emissions from fossil fuels such as natural gas that commonly serve this energy need.[47]

43 Woynillowicz, Dan and Petrevan, Sarah. "Canada can take clean stimulus lessons from Obama." The Hill Times. May 6, 2020. Retrieved from https://hilltimes.com/2020/05/06/canada-can-take-clean-stimulus-lessons-from-obama/246788; Beer, Mitchell. "Analysts Point to Green Recovery as Route to 'Shovel-Worthy Decade.'" The Energy Mix, May 6, 2020. Retrieved from https://theenergymix.com/2020/05/06/analysts-point-to-green-recovery-as-route-to-shovel-worthy-decade/

44 Canada Green Building Council. Building Solutions to Climate Change: How Green Buildings Can Help Meet Canada's 2030 Emissions Targets and Making the Case for Building to Zero Carbon.

45 Environment and Climate Change Canada. 2016.

46 Environment and Climate Change Canada. "Canadian Environmental Sustainability Indicators: Progress towards Canada's greenhouse gas emissions reduction target." 2020. Retrieved from http://canada.ca/en/environment-climate-change/services/environmental-indicators/progresstowards-canada-greenhouse-gas-emissions-reduction-target.html.

47 Ibid.

The COVID-19 pandemic slowed the global economy and reduced GHG emissions an unprecedented 17 percent, as government-mandated emergency measures drastically altered energy-demand patterns. Still, these only correspond to the level of emissions in 2006.

The COVID-19 economic crisis is distinct from those that came before because government responses severely constrained individual behaviour. Many questions remain unanswered as we finalized this report, including the duration and depth of the crisis, the shape of the recovery path, and the medium- and long-term impact on emissions.

Keeping track of evolving emissions can help inform government responses to the ongoing crisis and help avoid locking in carbon-intensive future emissions pathways. The extent to which governments consider their climate commitments when planning their economic responses to the crisis will likely influence the pathway of emissions for decades to come.[48]

Figure 21: GHG Emissions Reductions Under Forecast Scenarios

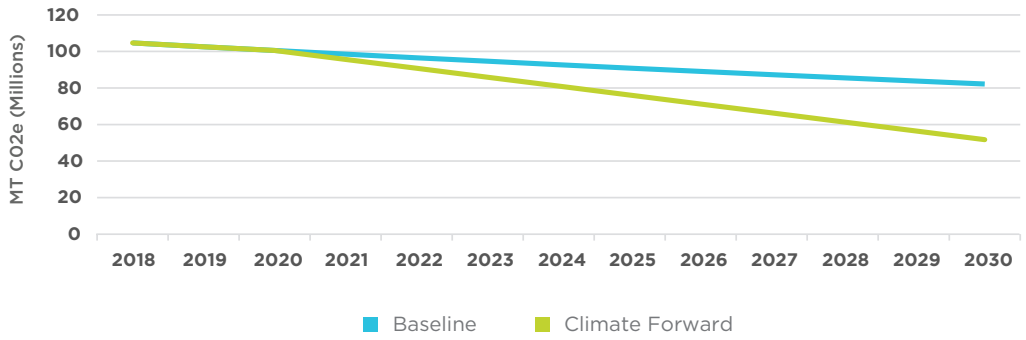
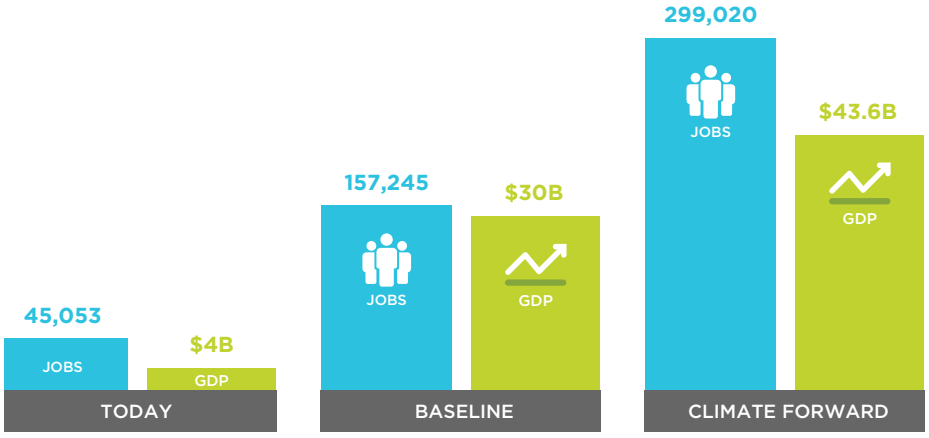


Figure 22: Retrofit Job and GDP Forecast Scenarios, Construction and Trades Sector (2030)[49]



48 Le Quéré, C., Jackson, R.B., Jones, M.W. et al. "Temporary reduction in daily global CO2 emissions during the COVID-19 forced confinement." Nature Climate Change. May 19, 2020. Retrieved from https://nature.com/articles/s41558-020-0797-x

49 Construction and Trades include the following NAICS codes: Residential building construction, Non-residential building construction, Utility system, Land Subdivision construction, Other heavy and civil engineering construction, Foundation, structure, and building exterior contractors, Building equipment contractors, Building finishing contractors, Other specialty trade contractors.

A Thriving Retrofit Economy

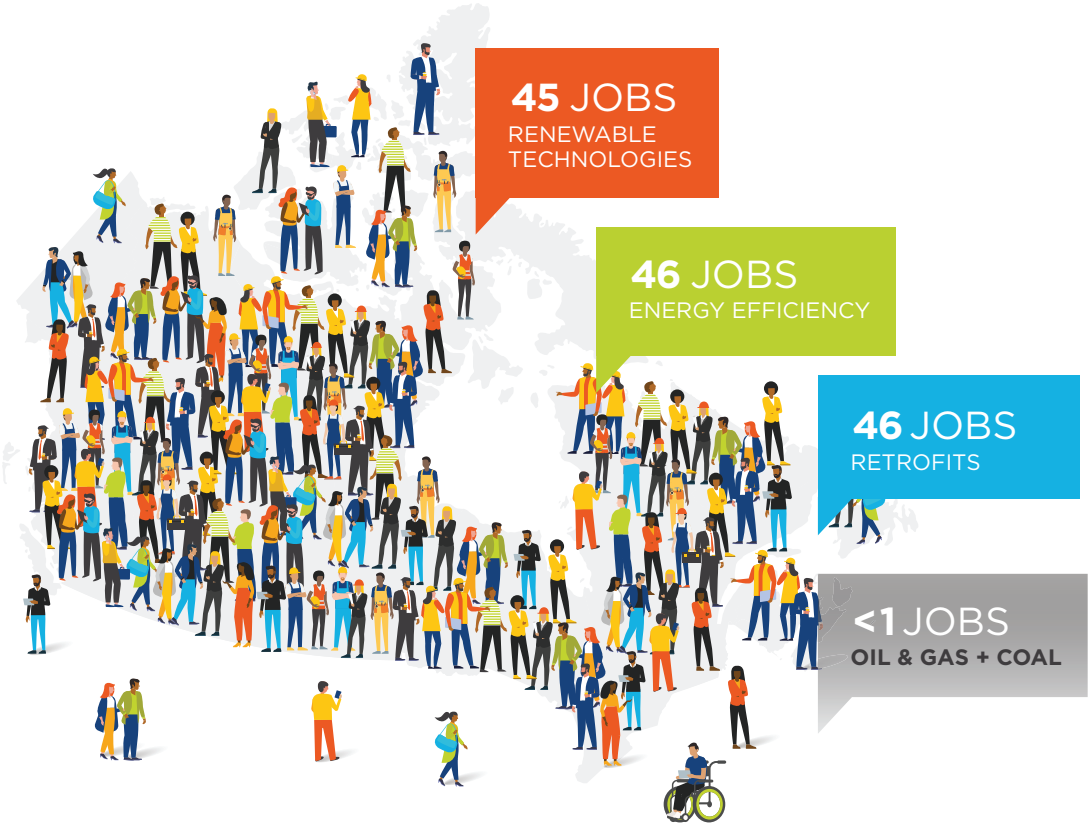
As we noted in the introduction to this report, new green building construction alone will not deliver Canada's 2030 GHG emission reduction target. That goal will only be reached if Canada reduces the emissions of its billions of square feet of existing institutional, commercial, and residential space.

Our modelling points to a significant growth of green building jobs in the retrofit economy. There are two main reasons that the GDP for green building retrofits in 2030 grow significantly in comparison to 2018:

- The amount of activity dedicated to retrofits has increased significantly to 65 per cent of total construction activity, whereas in 2018 the majority was new construction.
- By 2030 "penetration" (i.e., amount) of green building retrofits increases significantly, with the Climate Forward scenario exhibiting the greatest impact.

We also assume that 60 per cent of all residential buildings would receive a deep retrofit between 2020 and 2030. For retrofit calculations, we applied a blended direct jobs multiplier of 4.5 direct jobs per $1 million spend. For the Climate Forward scenario, we assume that by 2030, 30 per cent of all retrofits nationwide would be green retrofits and 65 per cent of all Canadian construction activity would relate to improving existing buildings. The scenario anticipates incremental investment in deeper retrofit and electrification equipment, such as heat pumps; these activities would not occur without government investment.

Figure 23: Jobs Created Directly per $10 Million in Spending in the Retrofit Economy (Climate Forward Scenario)



According to recent research, the oil and gas (plus coal) sectors generate less than one (0.94) direct jobs per $10 million investment, while renewable-power generation technologies generate 45 direct jobs, and energy efficiency generate 46 direct jobs for the same investment.[50] Our research assumes that the retrofit economy will create 45 additional direct jobs per $10 million additional dollars spent in 2030.[51] We can use these numbers to calculate the approximate employment impact of shifting $1 billion out of fossil fuel subsidies and into public investments in green retrofits. We conclude that the move would lower fossil fuel industry employment by a total of 940 direct jobs, while adding 4,500 direct jobs in the green building retrofit economy, for a net employment increase of 3,560 total jobs.

50 Garrett-Peltier, Heidi. "Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model." Economic Modelling 61 (2017), p. 439–447.

51 It is important to note that the jobs created in renewable-power generation technologies and energy efficiency should not be added to the ones we estimate to be created by the retrofit economy as there is some overlap in the sectors that fall under these categories.

PART C

Green buildings from Coast to Coast to Coast

In this section, we apply our 2018 data and growth scenarios at a provincial and territorial level to show the magnitude of the green building industry in terms of GDP and employment today and its potential for growth in the next 10 years. We particularly assess the economic impacts of significant government investment in green buildings in combination with progressive policies, as represented in GDP and employment, in different regions of the country. In each jurisdiction we also calculate green building jobs as a percentage of the overall construction workforce and the share of green building jobs.

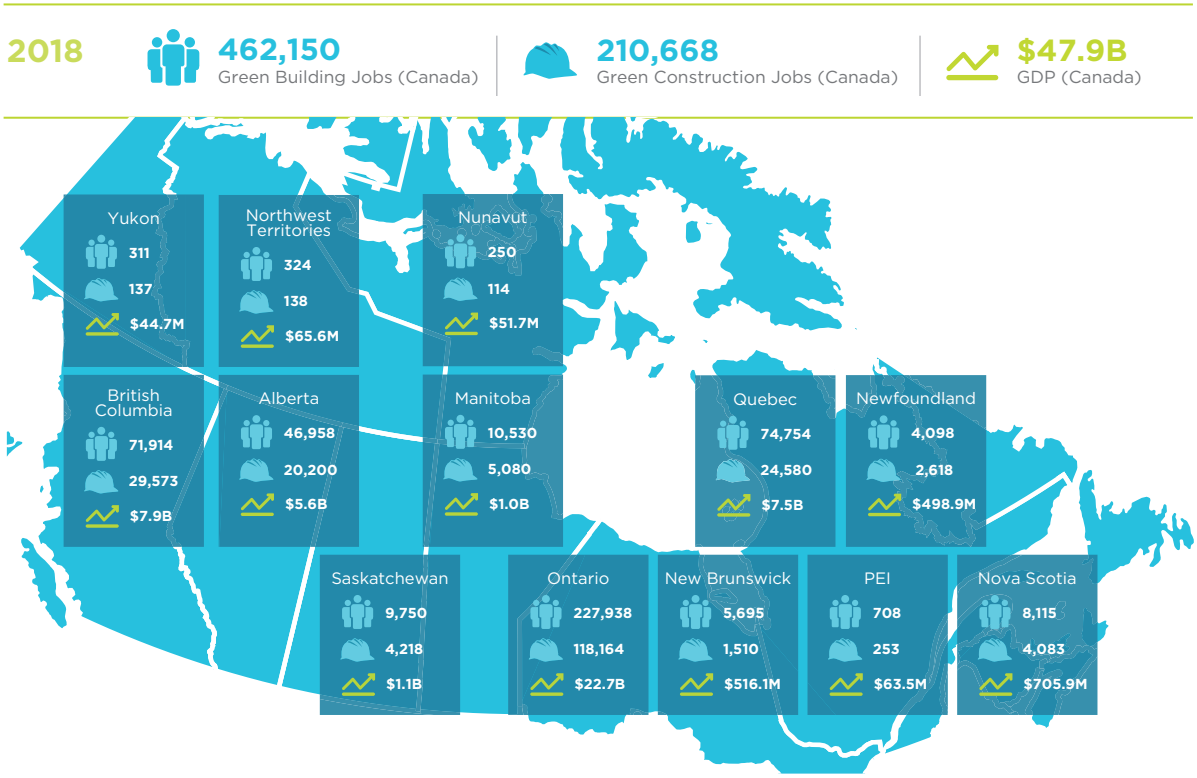
Factors and Assumptions Influencing Green Building Activity

Under our Climate Forward scenario, in 2030, 1.5 million Canadians will be working in the green building industry, of which 725,750 people, or 49 per cent, would work in the Construction and Trades sector. We assume under the scenario that Canada will reach its 2030 GHG reduction target, that 30 per cent of all retrofits will be green and low carbon by that year, and that approximately 90 per cent of all new construction will be net zero carbon.

We attribute provincial and territorial variations in green building economic activity to the amount of investment and certification activity as a share of total construction activity in each jurisdiction. In the residential segment, we consider the impacts of building codes and incentive programs, as well as the quantity of green building investment and jobs. Unsuprisingly, jurisdictions with more progressive building codes and municipal green building bylaws reveal a higher overall level of green building activity. Ontario and British Columbia have the highest amount of green building construction jobs as a percent of their total construction workforce.

With the exception of Prince Edward Island, over the most recent five years, all provinces have increased their green building jobs as a percentage of the overall labour force.

Figure 24: 2018 Direct Green Building Jobs, Green Construction Jobs and GDP by Province



The Greening of Canada's Workforce

Ontario and British Columbia currently show the highest percentage of green building jobs as a share of total workers across the economy, with 3.1 per cent and 2.9 per cent respectively. Approximately 210,760 people or 17 per cent of Canada's green building workforce are employed in construction and trades. Ontario claims the highest percentage of green building construction workers as a share of total construction jobs, equal to 23 per cent. British Columbia follows at 19 per cent.

Under our Climate Forward scenario, green building will constitute 43 per cent of all construction in Ontario in 2030. On average our projections show the pace of growth in green building activity at a steady nine per cent each year.[52]

Though Quebec is in second place in 2030 under our Climate Forward scenario, with green building constituting 21 per cent of all construction by that year, the sector will have grown from 2018's 16 per cent share, or 74,754 direct green building jobs. This reflects an average annual growth rate of 13 per cent. The scenario suggests Quebec would have 314,166 direct green building jobs in 2030 – more than four times 2018's total.

> The growth out to 2030 is quite remarkable; a huge portion of Canada's construction labour force will need upskilling to deliver low carbon, high performance buildings.

52 Previous Ontario governments introduced progressive policies to encourage more sustainable, energy-efficient, and low carbon buildings. However, the current government has in recent years dismantled sustainability programs; many remaining policies are voluntary or limited to government-owned buildings.

Though all provinces can meet the federal 2030 GHG target, some have a head start. For example, British Columbia had 71,914 green building jobs in 2018, which means it will "only" have to grow its green building labour force about two-and-a-half times to reach the target. This translates to an average annual growth rate of eight per cent.

The scenario also reveals that a much larger share of construction jobs would be greened across the country. The share will generally be in a similar range, from 58 per cent in British Columbia and New Brunswick, to 57 per cent in Manitoba and Ontario.

Today, we consider only 19 per cent of British Columbia construction jobs green, and only 10 per cent of such positions in Quebec. The growth out to 2030 is quite remarkable; a huge portion of Canada's construction labour force will need upskilling to deliver low carbon, high performance buildings.

Figure 25: 2030 Direct Green Building Jobs and GDP by Province in the Climate Forward Scenario

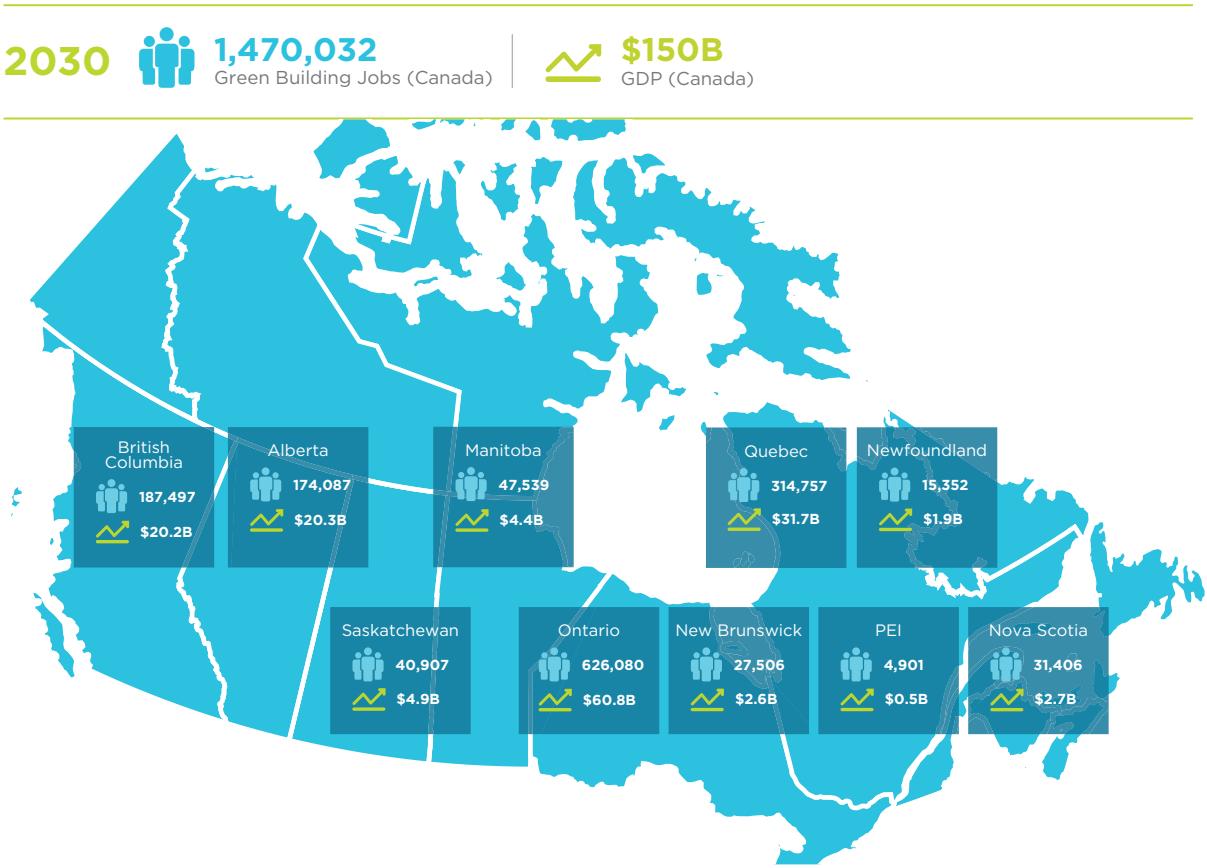
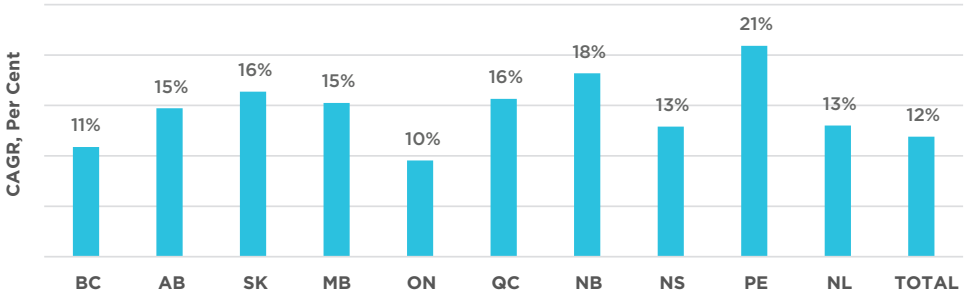


Figure 26: Compound Annual Growth Rate of Direct Construction and Trade Green Building Jobs in the Climate Forward Scenario (2020-2030)



Under our Climate Forward scenario, green building construction and trades jobs will grow across all provinces and territories. With 43 per cent of all construction and trades jobs across Canada, Ontario will continue to contribute the largest share of the green building workforce. However, our modelling shows the other provinces steadily catching up. In 2018, green building jobs constituted 22.5 per cent of Ontario's total construction workforce. By 2030 under the Climate Forward scenario, Ontario could reach 57 per cent.

Figure 27: Compound Annual Growth Rate of Direct Green Building Jobs Under the Recovery Scenario (Construction and Trades, 2020-2030)

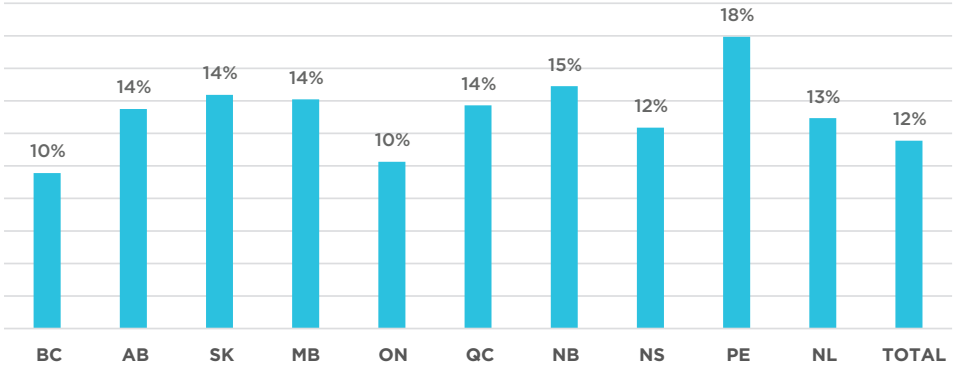
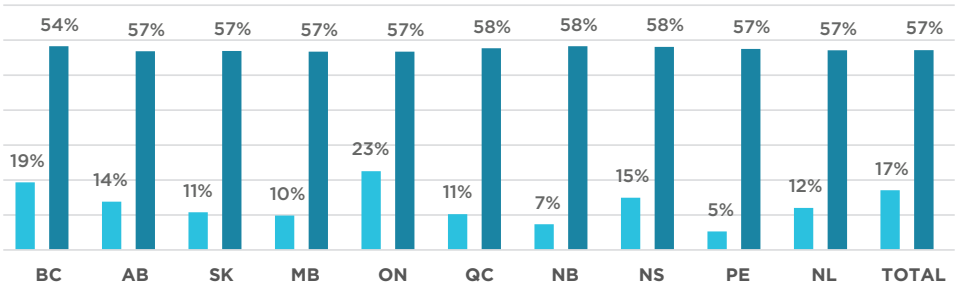


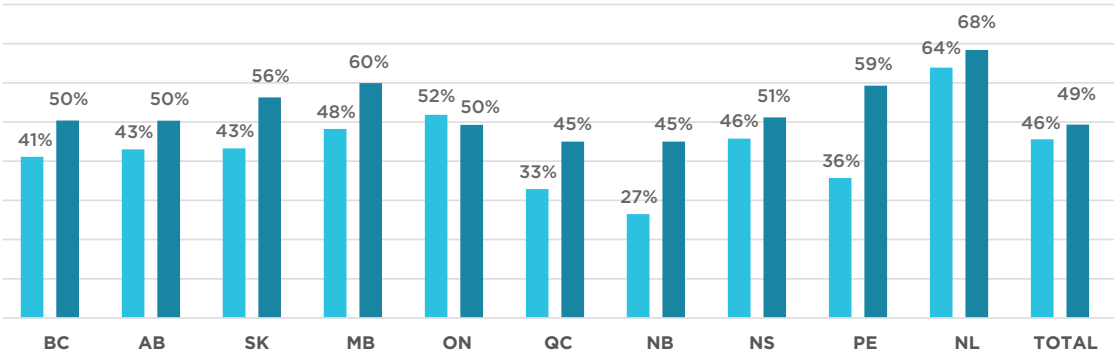
Figure 28: Green Building Construction Jobs as a Share of Total Construction Jobs (2018 and 2030)



■ GB Construction Jobs as % of Total Construction Jobs (2018) ■ % GB construction of total construction jobs 2030

As noted, we expect the percentage of green building construction jobs to grow quite dramatically in all provinces between today and 2030; Prince Edward Island, for example, will soar from its current five per cent to a staggering 53 per cent. The modelling shows British Columbia will have the highest percentage in 2030, with 58 per cent, rising from 19 per cent in 2018. Nationwide, the numbers grow from 17 per cent to 57 per cent.

Figure 29: Green Building Construction Jobs as Share of All Green Building Jobs (2018 and 2030)



■ % of GB construction jobs of total GB jobs 2018 ■ % of GB construction jobs of total GB jobs in 2030

Construction and Trade jobs constitute the largest percentage of green building jobs today, ranging from 27 per cent in New Brunswick to 64 per cent in Newfoundland and Labrador.

Increased activity in the green building sector – especially in the retrofit economy – will challenge industry to recruit new people and extensively upskill its existing workforce. The percentage of green building jobs as a share of all Construction and Trades jobs will increase even more, from 45 per cent in Quebec, to 68 per cent in Newfoundland and Labrador. On average, green building's penetration will be half of all green building jobs, at 50 per cent.

Segmented Green Building Economic Impact by Province and Territory

Below we assess the impact of our Climate Forward scenario for each of the provinces and territories, including their largest city. We detail each jurisdiction's current standing, then outline how a significant public investment in green buildings – as the centrepiece of a green COVID-19 recovery program – would generate employment and GDP while ensuring the nation meets its 2030 climate target.

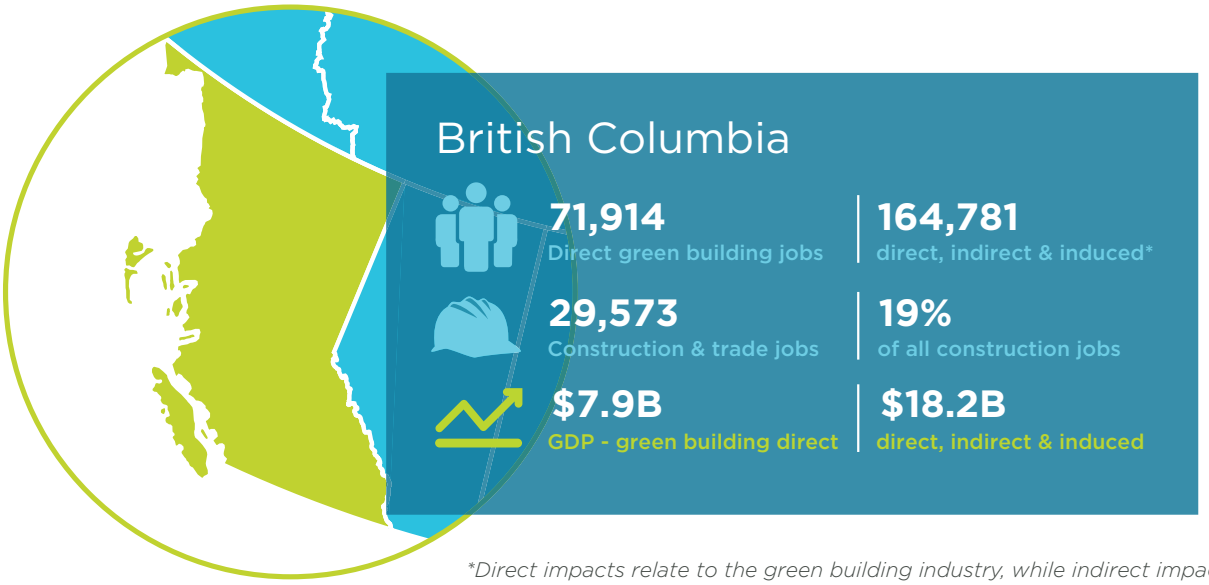
British Columbia

Provincial Green Building Impact

British Columbia long ago earned its reputation as a national green building leader. With its 2008 introduction of the carbon tax, it also became a global climate action leader. The province was also first to develop a climate action plan to meet its ambitious targets.

British Columbia moved to the front of the provincial pack in 2017 when it introduced the BC Energy Step Code as an optional compliance pathway in its building code. The regulation establishes performance requirements for new construction and groups them into "steps" available for various building types and regions. Each step represents an increasing level of building performance. All authorities having jurisdiction over the BC Building Code – including local governments – can choose to require or incentivize builders to meet one or more steps of the BC Energy Step Code as an alternative to the base code's prescriptive requirements.

Figure 30: Green Building Industry (British Columbia, 2018)



**Direct impacts relate to the green building industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct or indirect spending in the local economy outside of the green building industry (i.e. the economy as a whole).*

While builders and developers can meet the requirements of the Lower Steps without much difficulty, the Upper Steps demand considerably more attention to construction details, air barrier, and fenestration and equipment.

The BC Energy Step Code gives local governments a tool to increase energy efficiency in their communities, and the assurance that new buildings will perform as designed. Almost all of the local governments that host the majority of new construction have already adopted the regulation, and some have creatively leveraged the policy to advance their community climate objectives.

The City of Vancouver, as a charter city, established its own progressive building strategy. Its Zero Emissions Building Plan aims to slash emissions from new buildings 90 per cent by 2025; by 2030, it targets zero emissions from all newly permitted buildings.

By 2022, the equivalent requirements of the Step 3 of the BC Energy Step Code will become the minimum legal energy-efficiency requirement across the province. Effective that year, Part 9 residential builders will need to demonstrate their new projects perform at a level that is roughly 20 per cent better than what was expected of them under the 2018 base building code.

The Upper Steps, Steps 4 and 5, will remain optional for Part 9 homes. However, the province has signaled that its requirements will increase again in 2027, approximately 20 per cent (the equivalent of Step 4 for Part 9) until it reaches its 2032 goal of all net-zero energy-ready new construction.

Over the coming decade, both the Province of British Columbia and the City of Vancouver are considering code amendments to encourage more energy efficient, low carbon retrofit activities for detached homes, multi-unit residential, commercial, and institutional buildings. The BC Energy Step Code only applies to new construction. However, in its 2018 CleanBC Plan, the province pledged to develop, by 2024, an energy code for alterations to existing buildings. It is developing a multipronged strategy for alterations to existing buildings, both residential and commercial, and plans to publish it in early 2021. British Columbia expects the ASHRAE standard for existing buildings will inform its strategy. The government has reportedly developed energy benchmarks for 15 building types and intends to develop greenhouse gas (GHG) metrics for them as well.[53]

These amendments would also be in line with regulations to encourage energy efficiency retrofits for existing buildings in Canada, currently being considered as part of updates to the National Energy Code of Canada for Buildings (NECB). The amendments would be phased in over time, likely between 2022 and 2030. Retrofit requirements may be triggered at time of renovation, by major milestone date, or through annual reporting requirements.

Local Green Building Impact

In 2019, the City of Vancouver declared a climate emergency and began planning and introducing new policies to address it. These include a forthcoming Zero Emission Building Retrofit Strategy, which will include a new regulatory structure for building energy use and limits on carbon pollution. This will set a cap, or maximum amount, of fossil fuels such as natural gas that a building can use in its operations, including space and water heating. Electricity is a minor consideration for greenhouse gas emissions in British Columbia, where at least 94 per cent of grid power is non-emitting.

Vancouver plans to begin setting modest limits for the largest commercial buildings around 2025

53 Nadel, Steven and Hinge, Adam. "Mandatory Building Performance Standards: A Key Policy for Achieving Climate Goals." American Council for an Energy-Efficient Economy. 2020. Retrieved from: https:// aceee.org/sites/default/files/pdfs/buildings_standards_6.22.2020_0.pdf

for offices, before progressing to other building types by 2030. It aims to encourage owners and managers to create a carbon pollution reduction plan aligned with their routine building maintenance and equipment replacement schedules, and other planned upgrades. Every five years, the limits will decrease.

For homes and many other building types, Vancouver will encourage builders to use heat pumps for space and water heating and other high efficiency renewable-energy-powered mechanical systems for in-building heat applications, and upgrades to windows, doors, insulation, and direct ventilation, when existing equipment needs replacement.

For single-family homes, Vancouver is considering an absolute target of a specified number of tonnes of carbon emissions per year; this would, on average, effectively require more reductions from large homes than from smaller ones. However, before developing specific targets, the city plans to introduce a variety of foundational steps, such as developing a decision-support tool for homeowners and improving the heat pump supply chain. Multifamily and rental units will be among the last building types regulated. Plans are to develop recommendations for council consideration in fall 2020, for the largest commercial buildings and for detached homes.[54]

In 2016, the City of Vancouver released its Zero Emissions Building Plan, which requires most new buildings to be near zero emissions by 2025 and all new buildings to be zero emissions by 2030. In 2018, the Vancouver Regional Construction Association, in partnership with the City of Vancouver, Passive House Canada, and the Open Green Building Society established the Zero Emissions Building Centre of Excellence (ZEBx). The centre aims to support the industry through this transition, acting as a catalyst that transforms the entire design and construction value chain towards cost-effective, attractive, zero emission buildings.

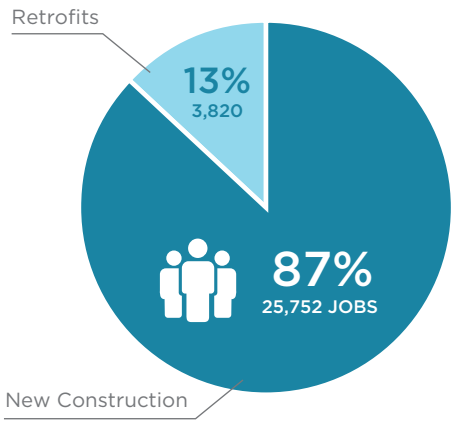
With respect to LEED® participation, to date 678 British Columbia buildings have achieved certifications, and another 1,634 are registered to do so. Between 2015 and 2019, 423 buildings achieved the BOMA BEST® certification, while 16 achieved Passive House certification between 2015 and 2019.

Employment and GDP

In 2018, British Columbia's green building sector employed 71,914 people, which is three per cent of total employment, with 29,573 workers in the Construction and Trades sector representing 19 per cent of the total construction sector. The GDP direct from green building is estimated to be $7.9 billion. The retrofit economy employs 13 per cent of the province's green construction workforce in 3,829 jobs.

When also considering indirect and induced jobs, the green building industry offers 164,781 jobs and generates an estimated GDP of $18.2

Figure 31: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (British Columbia, 2018)



54 Nadel, Steven and Hinge, Adam. "Mandatory Building Performance Standards: A Key Policy for Achieving Climate Goals." Alliance for an Energy Efficient Economy. June 22, 2020. Retrieved from https://aceee.org/sites/default/files/pdfs/buildings_standards_6.22.2020_0.pdf

billion. The influence of green building certification is 64 per cent in the province for non-residential buildings.

British Columbia's construction sector will grow significantly in the coming decade. Our Climate Forward scenario assumes the province will reach its GHG targets. Should the provincial government opt to increase investment in green buildings and introduce progressive and supporting policy, by 2030 the green building sector could provide as many as 187,497 direct green building industry jobs and a GDP of $29.5 billion.

Figure 32: Green Building Direct Jobs and GDP Forecast by Scenario (British Columbia, 2030)

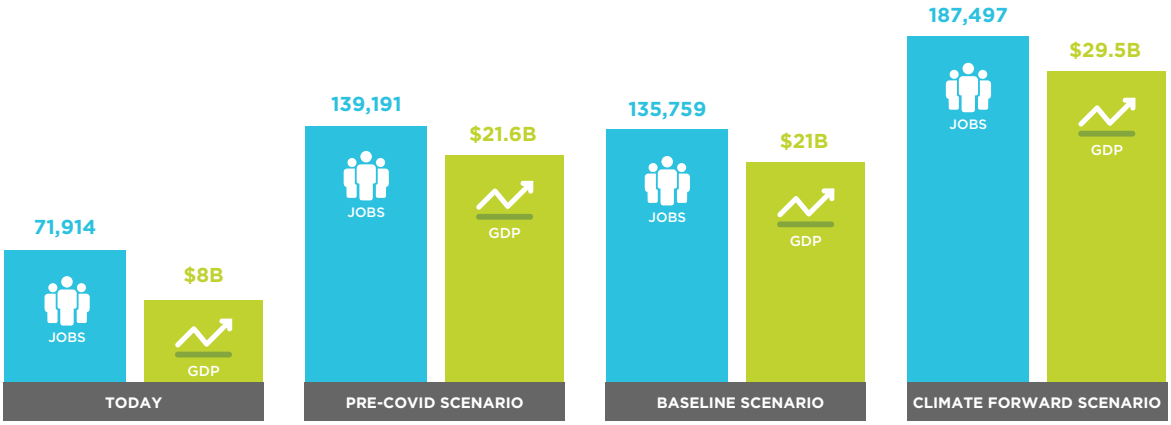
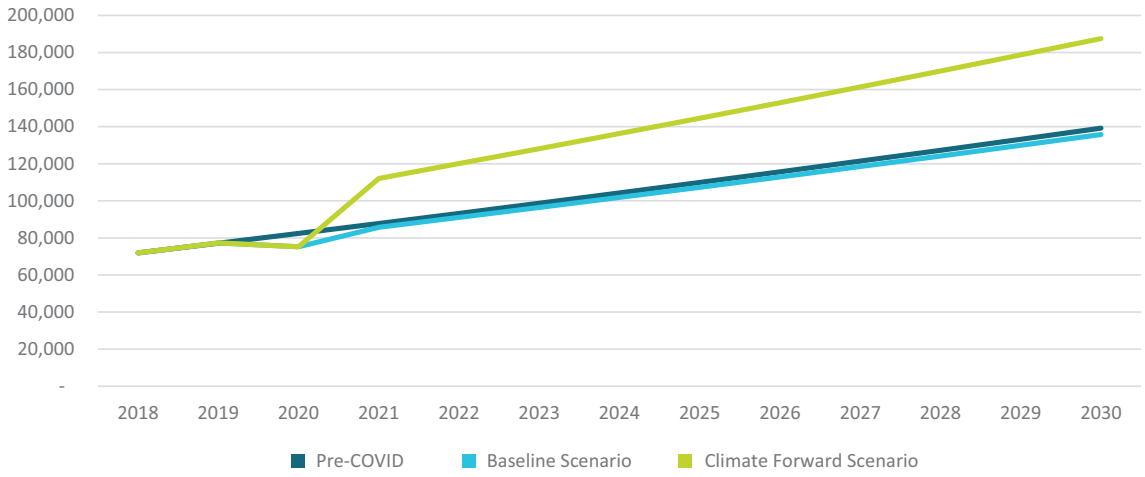


Figure 33: Green Building Direct Jobs Growth Forecast (British Columbia 2018-2030)



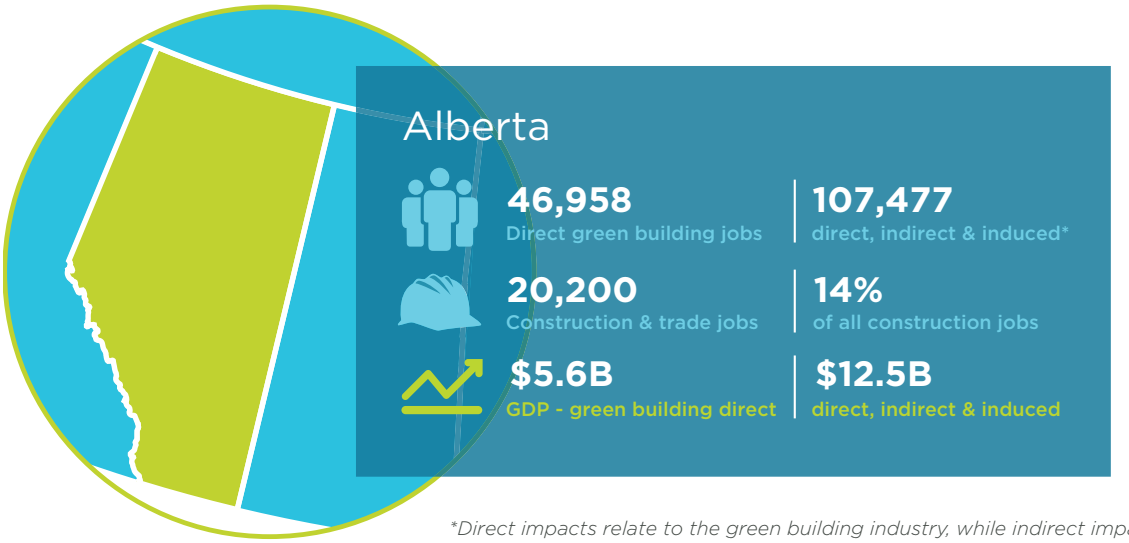
Alberta

Provincial Green Building Impact

Like its neighbour to the west, Alberta has a long history with green buildings. As of January 2020, the province boasted 111.2 million square feet under LEED® certification with 633 buildings, the highest total per capita in Canada. More than double that number of buildings are in the certification queue.

From 2005 to 2019, LEED® buildings in Alberta have saved 3.4 million megawatt-hours equivalent (eMWh) of energy – enough to power 114,092 homes for a year. These buildings also averted the release of more than 637,686 Mt CO_2e, the equivalent impact associated with taking 135,678 cars off the roads for a year.

Figure 34: Green Building Industry (Alberta, 2018)



**Direct impacts relate to the green building industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct or indirect spending in the local economy outside of the green building industry (i.e. the economy as a whole).*

These achievements are largely the result of a provincial policy that requires a minimum of LEED® Silver for all major government construction projects. LEED® Silver buildings are up to 45 per cent more energy efficient than the performance required under the model National Energy Code of Canada for Buildings. In addition, between 2015 and 2019, 716 Alberta buildings received BOMA BEST® certification.

Alberta's carbon intensive grid will challenge the province in its transition to green buildings. The Alberta Electric System Operator continues its work to phase out coal plants, and the province's Renewable Energy Program aims to add five gigawatts of renewable energy capacity to the grid by 2030.[55]

For several years the province had an agency dedicated to energy efficiency, Energy Efficiency Alberta. However, in September 2020 the government dismantled Energy Efficiency Alberta and

55 "Renewable Energy in Alberta." Government of Alberta. https://alberta.ca/renewable-energy-in-alberta.aspx

shuffled its budget and responsibilities to other departments. In its second and final annual report, Energy Efficiency Alberta estimated its programs had delivered $850 million in economic growth and had returned $3.20 to Albertans for every $1 invested.[56]

Local Green Building Impact

In early 2019, Alberta adopted the National Energy Code of Canada for Buildings 2017. But in municipalities such as Calgary and Edmonton, climate change and green building policies go much further.

The City of Calgary demonstrated exceptional leadership in 2004 with the first iteration of its Sustainable Building Policy which required LEED® certification. (The city updated the policy in spring 2019.) Calgary now hosts 319 LEED® certified green buildings. Since 2004, another nine Alberta municipalities and the provincial government have adopted similar green building policies.

Under Calgary's Sustainable Building Policy, all planning, design, construction, management, renovation, operation, and demolition of city owned and/or financed facilities must be carried out in a sustainable manner with consideration for triple-bottom-line impacts (social, environmental, and financial). As the first jurisdiction in Canada to require green building certification of all new public buildings, Calgary not only demonstrated significant leadership, but also helped rapidly expand its local industry capacity. The city continues to champion best practices in new construction and renovations by applying lessons learned from certified buildings and by referencing staff-developed and maintained design guidelines.[57]

Alberta's capital city is pursuing a similar path. The City of Edmonton's 2017 Sustainable Building Policy established ambitious requirements for city owned, leased, and funded buildings, as well as energy standards for new residential construction. The city is also planning changes to building codes and is currently lobbying the provincial government to introduce an Alberta Energy Step Code in 2021.

Edmonton has also committed to reduce its building carbon emissions in support of its ultimate goal of carbon neutrality. In addition, in 2019, city council declared a climate emergency; as a result, the city now requires all new homes to meet minimum EnerGuide standards.[58]

Edmonton's Building Energy Benchmarking Program improves building energy efficiency and contributes to significant energy savings and greenhouse gas (GHG) reductions by providing building owners with information about their properties. The program supports building owners and operators to reduce energy consumption and will eventually help them transition to a mandatory building energy labeling initiative announced by the federal government in the Pan Canadian Framework on Clean Growth and Climate Change. The program is for owners and operators of Edmonton buildings larger than 10,000 square feet. Participants benefit from technical support, customized building benchmarking reports, tenant education workshops, and access to financial

56 Bennet, Dean. "Alberta government officially ends agency created to handle green rebates and programs." The Canadian Press. June 11, 2020. Retrieved from: https://globalnews.ca/news/7056892/ucp-government-kenney-energy-efficiency-alberta/

57 "Sustainable Building Policy CS005." City of Calgary. Amended April 29, 2019. Retrieved from: https://calgary.ca/content/dam/www/ca/city-clerks/documents/council-policy-library/cs005-sustainable-building-policy.pdf

58 "Energy Transition." City of Edmonton. Retrieved from: https:// edmonton.ca/city_government/city_vision_and_strategic_plan/energy-transition.aspx; "Sustainable Building Policy." City of Edmonton. May 9, 2020. Retrieved from: https://edmonton.ca/city_government/documents/PoliciesDirectives/C532.pdf; "Edmonton City Council declares climate emergency." City of Edmonton. August 27, 2019. Retrieved from: https://changeforclimate.ca/story/edmonton-city-council-declares-climate-emergency

incentives ($10,000 per building) to help offset the cost of an energy audit.[59]

Edmonton's Building Energy Retrofit Accelerator provides financial incentives for energy efficiency upgrades to commercial and institutional buildings. The program aims to reduce emissions from commercial, light industrial, and institutional buildings via rebates on energy-efficient equipment. Eligible expenses include building lighting fixtures and controls, heating, ventilation, and air conditioning (HVAC) equipment, hot water equipment, building controls, building envelope compvonents, and green building certifications.[60]

Employment and GDP

In 2018, Alberta's green building sector employed 46,958 people, representing two percent of the province's total employment. The Construction and Trades sector employs 20,200 of those workers, representing 14 per cent of the construction sector overall. Green building GDP is about $5.6 billion. When also considering indirect and induced jobs, Alberta's green building industry provides 107,477 jobs and generates an estimated provincial GDP of $12.5 billion.

We expect Alberta's construction sector will see significant growth in the coming years. Our Climate Forward scenario assumes that the province will reach its GHG targets. Should the provincial government opt to increase investment in green buildings and introduce progressive and supporting policy, by 2030 the green building sector could provide as many as 174,087 jobs and a GDP of $20.3 billion.

The influence of green building certification is 72 per cent in Alberta for non-residential buildings and 16 per cent for residential buildings – both figures among the highest in Canada. (The Canadian average is 51 per cent for non-residential and four per cent for residential buildings.)

Figure 35: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Alberta, 2018)

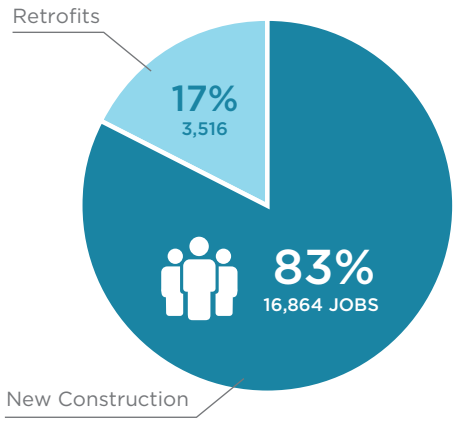
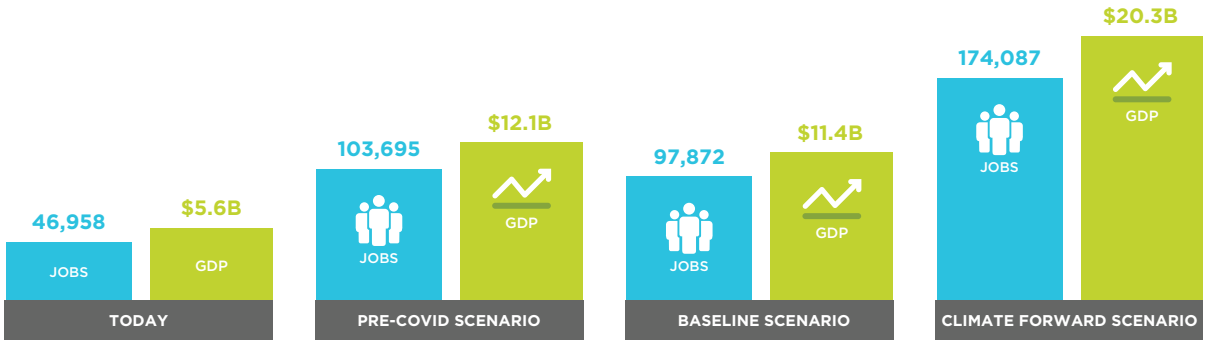


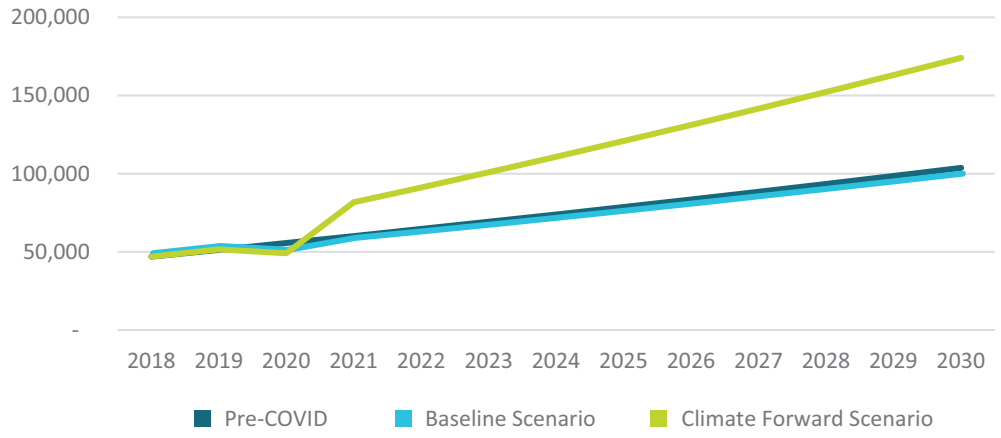
Figure 36: Green Building Direct Jobs and GDP Forecast by Scenario (Alberta, 2030)



59 "Building Energy Benchmarking Program." City of Edmonton. Retrieved from: https://edmonton.ca/programs_services/environmental/building-energy-benchmarking-program.aspx

60 "Building Energy Retrofit Accelerator." City of Edmonton. Retrieved from: https://edmonton.ca/programs_services/environmental/building-energy-retrofit-accelerator.aspx

Figure 37: Green Building Direct Jobs Growth Forecast (Alberta, 2018-2030)

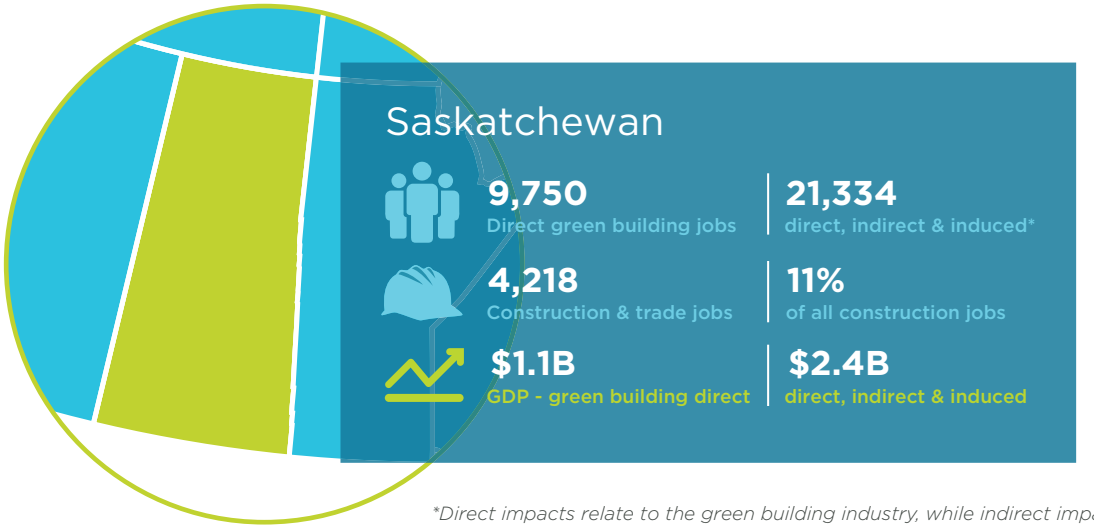


Saskatchewan

Provincial Green Building Impact

The Government of Saskatchewan has historically made limited investments in green building. Between 2008 and 2015, the province invested $60 million in GoGreen funding to reduce GHG emissions, enhance biodiversity, and educate the public about the impacts of climate change. Saskatchewan has developed technologies to save energy in the built environment, and Natural Resources Canada codified those innovations in its R-2000 standard for energy efficient homes.

Figure 38: Green Building Industry (Saskatchewan, 2018 and 2030)



**Direct impacts relate to the green building industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct or indirect spending in the local economy outside of the green building industry (i.e. the economy as a whole).*

In 2017, the province launched its Prairie Resilience climate strategy, which in part calls for consideration of environmental sustainability in public buildings. It also calls for consideration of

the life-cycle costs of new buildings and improving the energy efficiency of existing buildings to match the province's specific geography and climate demands. The plan also highlights additional government commitments, including the requirement for new and renovated government buildings to exceed the energy performance requirements of the 2015 National Energy Code of Canada for Buildings by 10 percent.[61]

The province missed its target to cut greenhouse gas (GHG) emissions 20 per cent by 2020, and has yet to establish a new target to replace it.

Saskatchewan has committed to incorporate environmental sustainability in government building operations and adopt environmental standards for all new construction projects including LEED® and BOMA BEST® certifications. The province has 71 projects that have achieved LEED® certification, equalling 6,733,505 square feet, and another 130 projects registered to certify. Further, 92 projects in the province achieved BOMA BEST® certifications.

Local Green Building Impact

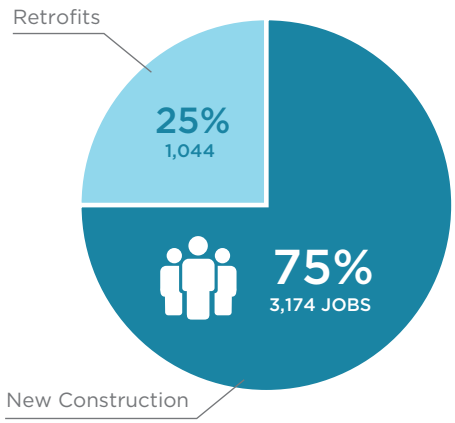
In 2017, the City of Saskatoon set GHG targets to reduce its emissions 40 per cent below 2014 levels by 2023, and 80 per cent by 2050. The city has constructed four LEED® buildings since 2014.[62]

Both of the province's major utilities, SaskPower and SaskEnergy, provide information and energy rebates to help customers adopt energy efficiency measures and lower their energy use. The province also exempts provincial sales tax on new energy efficient household appliances and on new ENERGY STAR® qualified furnaces, boilers, and heat pumps. Saskatchewan Housing Corporation's Home Energy Improvement program assists low- to moderate-income homeowners with heating system upgrades and insulation.

Employment and GDP

In 2018, Saskatchewan's green building sector directly employed 9,750 people, which is 1.7 per cent of total employment. The Construction and Trades sector employs 4,218 workers, representing 11 per cent of the total construction sector, and 43 per cent of total green building jobs in Saskatchewan. We estimate provincial green building related GDP at $1.1 billion. The retrofit economy employs 25 per cent of the province's green construction workforce in 1,044 jobs. When also considering indirect and induced jobs, the green building industry offers 21,334 positions in Saskatchewan and generates an estimated provincial GDP of $2.4 billion. The influence of green building certification is 54 per cent in the province for non-residential buildings.

Figure 39: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Saskatchewan, 2018)



61 Prairie Resilience: A Made-in-Saskatchewan Climate Change Strategy, p.7

62 "Climate Action Plan." City of Saskatoon. Retrieved from: https://saskatoon.ca/community-culture-heritage/environment/climate-change; "Corporate Climate Adaptation Strategy - Local Actions: Saskatoon's Adaptation Strategy (Part Two)." December 2019. Retrieved from: https://saskatoon.ca/sites/default/files/documents/local_actions_report-ccap-nov28.pdf.

Our Climate Forward scenario assumes that the province will reach its GHG targets. However, achieving these targets will be challenging as successive governments have not made significant progress on green building investments, regulation, and policy development. Should the provincial government pursue a path that leverages the green building industry to meet its climate objectives, then by 2030 the green building sector could provide as many as 40,907 direct green jobs and $4.9 billion in GDP.

Figure 40: Green Building Direct Jobs and GDP Forecast by Scenario (Saskatchwan, 2030)

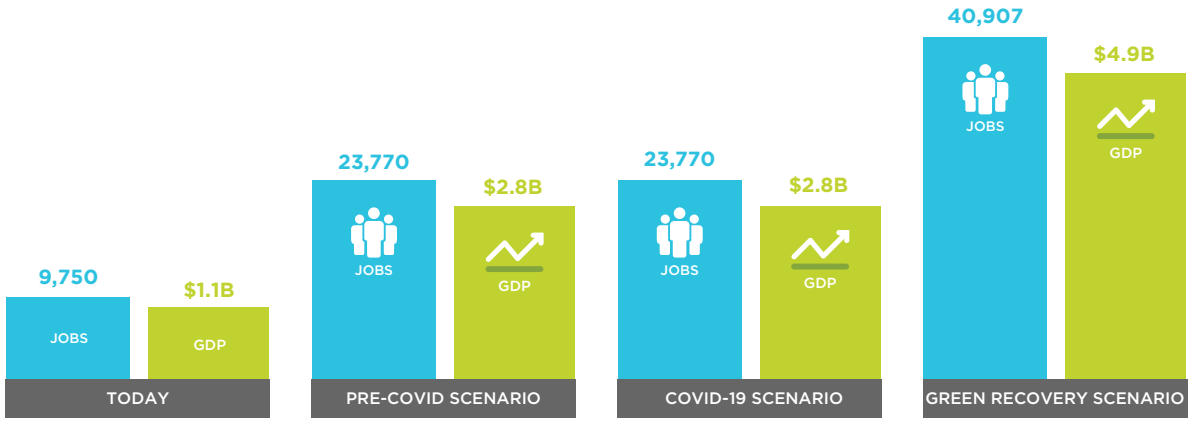
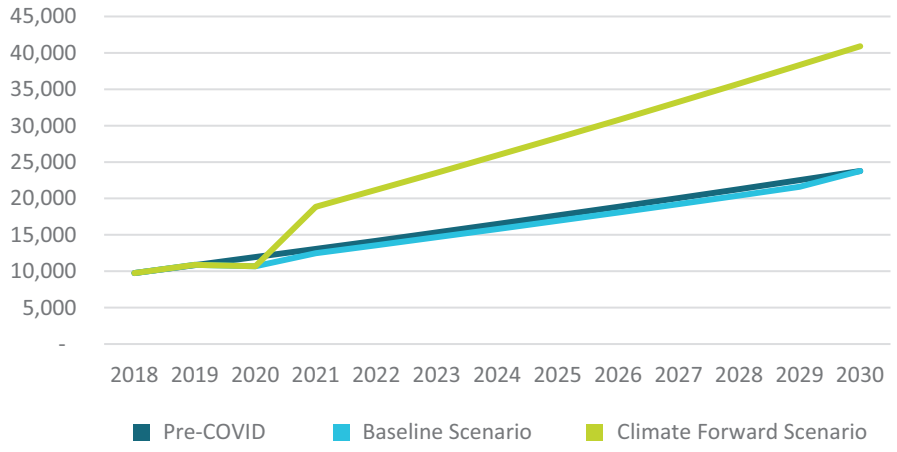


Figure 41: Green Building Direct Jobs Growth Forecast (Saskatchwan, 2018-2030)

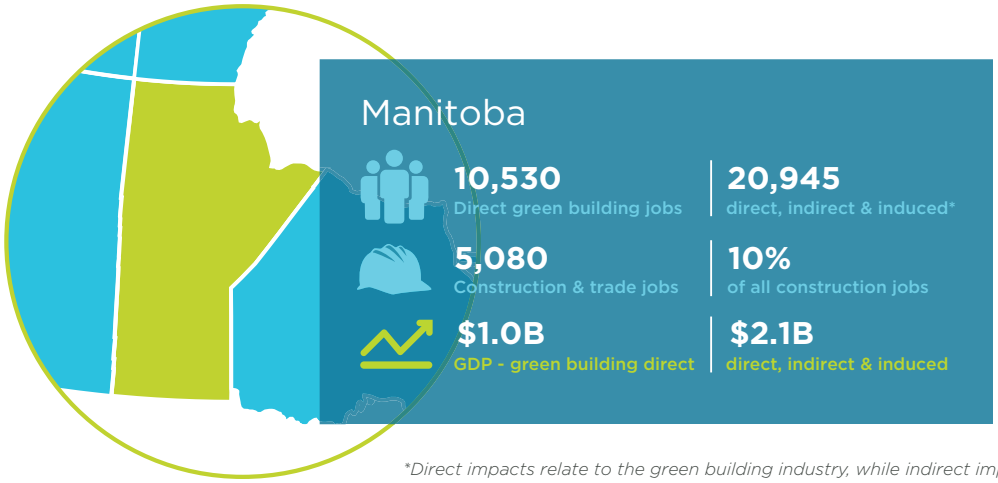


Manitoba

Provincial Green Building Impact

Manitoba's first Green Building Policy came into effect in 2007, covering non-residential, provincially funded projects. The policy promotes sustainable building and requires government departments, agencies, and crown corporations to implement the criteria identified in Manitoba's Green Building Program. The province updated the policy in December 2013; it references LEED® but stops short of requiring certification.

Figure 42: Green Building Industry (Manitoba, 2018)



**Direct impacts relate to the green building industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct or indirect spending in the local economy outside of the green building industry (i.e. the economy as a whole).*

In late 2014, Manitoba adopted the 2011 edition of the National Energy Code of Canada for Buildings, making only minor modifications and naming it the Manitoba Building Energy Code.[63] There is currently no indication if, or when, the province will adopt the 2015 or 2017 editions of this model national code. The province requires publicly owned and funded new buildings to meet Power Smart Guidelines.[64]

Manitoba Race to Reduce launched in 2017 as a corporate energy reduction challenge encouraging commercial building landlords and tenants to reduce energy consumption in their properties. Participants agree to benchmark their energy consumption, and reduce it 10 per cent over four years. The voluntary program currently has more than 7.5 million square feet of commercial office space registered. A large percentage of government buildings have also participated.[65]

Manitoba is exceptionally positioned for building energy benchmarking as it has only one utility, and it is already connected to NRCan's Portfolio Manager.

As of January 2020, Manitoba has 128 projects that have achieved LEED® certification, equalling 8,744,582 square feet, and another 288 projects registered to certify. Further, 75 projects in the province achieved BOMA BEST® certification.

63 "Adoption of The National Energy Code for Buildings." Province of Manitoba. Office of the Fire Commissioner. November 28, 2014. Retrieved from: http://firecomm.gov.mb.ca/codes_energy.html

64 https://gov.mb.ca/finance/greenbuilding/pubs/section4.pdf

65 https://manitobaracetoreduce.ca/about_manitoba_race_to_reduce

Local Green Building Impact

The City of Winnipeg developed a Green Building Policy for new city-owned buildings and major additions in 2011. It mandates that all new municipal buildings must be LEED® Silver or obtain three Globes under the Green Globes for New Construction certification program.[66] The Green Building Policy mandates all new city-owned buildings, renovations, and additions of more than 5,400 square feet must be designed and constructed to achieve improved energy performance, and achieve certification in accordance with a credible, third-party verified, integrated design-based green building standard such as LEED®. The municipality has also incorporated a Green Building Policy for Existing City-Owned Buildings which includes criteria for energy and greenhouse gas (GHG) emission benchmarking of existing city-owned properties.

Employment and GDP

In 2018, the green building sector in Manitoba directly employed 10,530 people, which is 1.6 per cent of total employment, with 5,080 workers in the green building Construction and Trades sector representing 10 per cent of the total construction sector and 48 per cent of the province's total green building jobs. We estimate GDP to be $1 billion. The retrofit economy employs 23 per cent of the province's green construction workforce in 1,149 jobs. When also considering indirect and induced jobs, Manitoba's green building industry offers 20,945 jobs and generates an estimated $2.1 billion provincial GDP. The influence of green building certification is 56 per cent in the province for non-residential buildings.

Figure 43: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Manitoba, 2018)

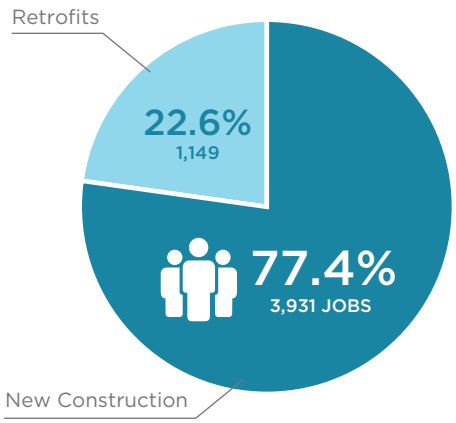
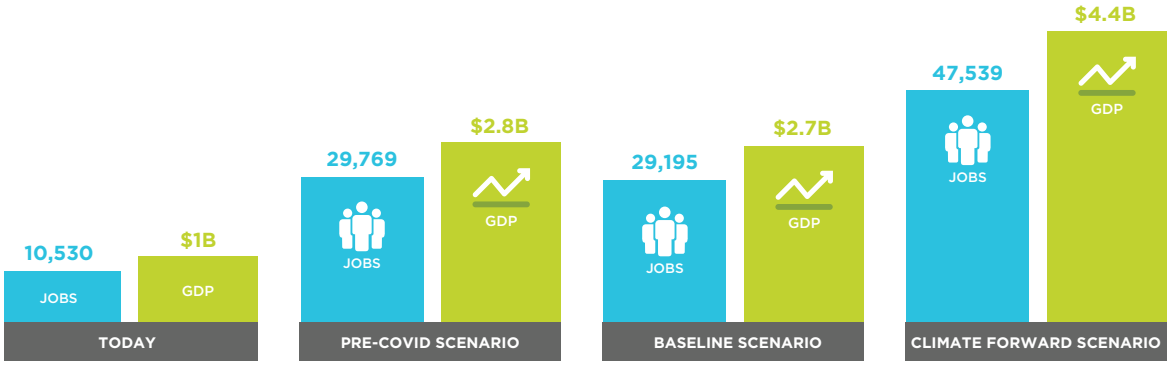


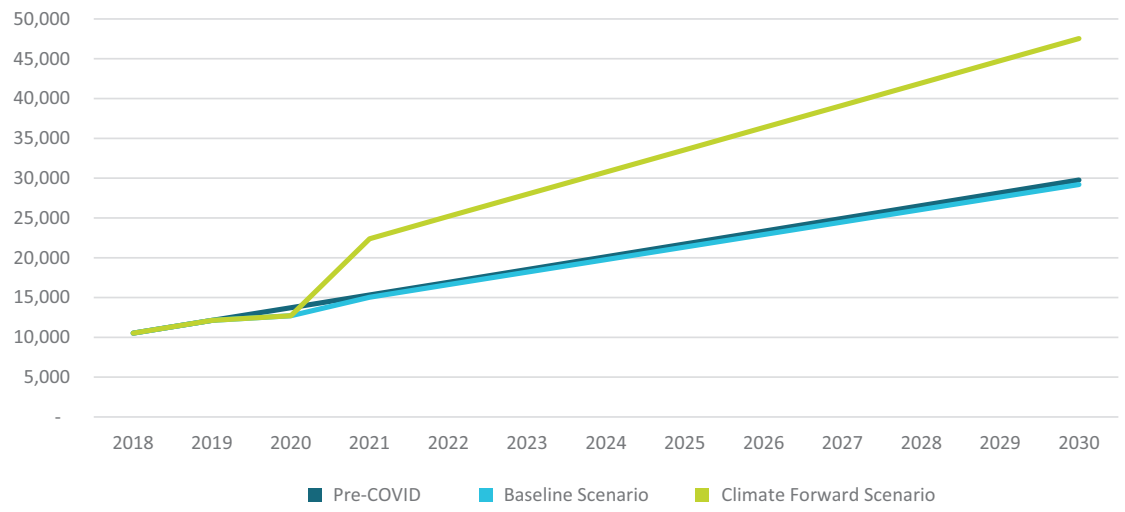
Figure 44: Green Building Direct Jobs and GDP Forecast by Scenario (Manitoba, 2030)



66 "Green Buildings." City of Winnipeg. Retrieved from: https://winnipeg.ca/sustainability/GreenBuildings.stm

Should the provincial government opt to increase investment in green buildings and introduce progressive and supporting policy, by 2030 the green building sector could provide as many as 47,539 direct green building jobs and $4.4 billion in GDP. Our Climate Forward scenario also assumes that the province will reach its GHG targets.

Figure 45: Green Building Direct Jobs Growth Forecast (Manitoba, 2018-2030)



Ontario

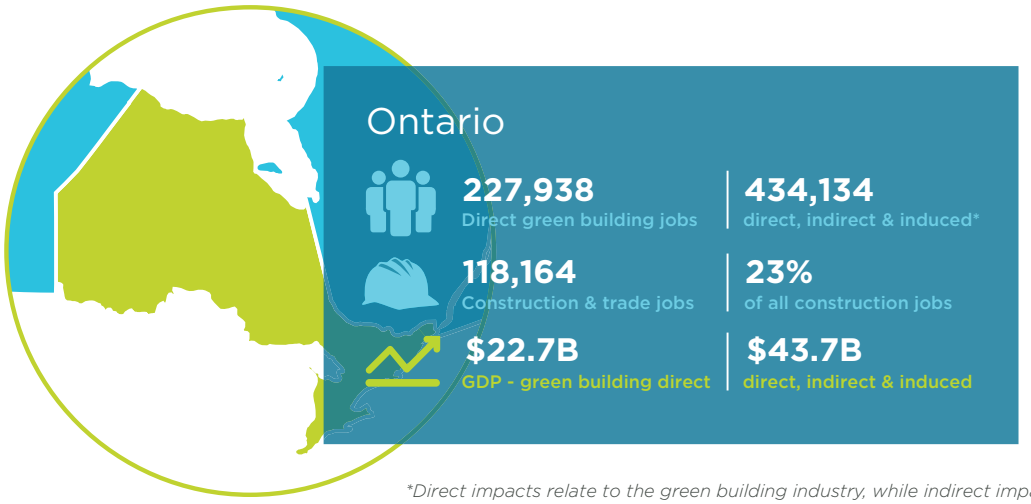
Provincial Green Building Impact

As the population of Ontario grows by an estimated 193,000 more people per year, the demand for residential development is growing. In fact, in 2018, more than 75,000 new homes were constructed in the province, making it one of the fastest growing regions in Canada. The Greater Toronto Area (GTA) region is projected to be the fastest growing region of the province, with its population increasing by 3.4 million, or 50 per cent, from 6.8 million in 2018 to more than 10.2 million by 2046. This increase in population must be met with an increase in new development. Rapid growth and urbanization bring new pressures and increasing challenges for municipalities, especially in Ontario.[67]

Not surprisingly, with 43 per cent, Ontario contributes the largest share of the construction and trade workforce. However, we see a continuous catching up process of the other provinces. An explanation for this might be that other provinces have been more progressive in the development of their codes whereas Ontario has not updated its building code for several years and is no longer leading the sector.

67 Clean Air Partnership.

Figure 46: Green Building Industry (Ontario, 2018)



**Direct impacts relate to the green building industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct or indirect spending in the local economy outside of the green building industry (i.e. the economy as a whole).*

Ontario's Building Code Act governs the construction, renovation, and change of use of buildings. The Ontario Building Code – a Building Code Act regulation – in turn establishes technical requirements and minimum standards for construction. The code defines the minimum acceptable level of energy efficiency performance through the Supplementary Standard SB10 (SB-10). The government had intended to increase the SB-10's stringency every four years.

For example, the 2012 iteration of the SB-10 proved 15 per cent more efficient than the 2006 version. The subsequent 2017 edition was 13 per cent more efficient than the 2012 one. As of the writing of this report, proposed code changes aim to "step" the requirements of new houses and large buildings towards net zero, but these have yet to come into effect. The Supplementary Standard SB-12 exceeds NBC energy efficiency standards, which exceed EnerGuide 78, and the Supplementary Standard SB-10 references the National Energy Code of Canada for Buildings 2015, and can be assumed to be equal to the 2017 national energy code.

The Ontario Building Code exists primarily to ensure minimum health and safety standards, and offers little to local governments that wish to support improved building performance and community design. However, the Municipal Act, Planning Act, and Provincial Policy Statement all support green development standards.[68]

The Province of Ontario, through Infrastructure Ontario, requires LEED® Silver of all new public buildings. Further, Ontario is the only province with a mandatory energy benchmarking program, the Energy and Water Reporting and Benchmarking (EWRB) initiative.

Between 2015 and 2019, the Building Owners and Managers Association of Canada certified 1,302 of the province's buildings as BOMA BEST® – 40 per cent of all such certifications in the country. Meanwhile, as of January 2020, CaGBC had certified 1,762 LEED® buildings in the province, which represents 40 per cent of all LEED® certified buildings in Canada.

68 Ibid.

Local Green Building Impact

The Ontario Planning Act, R.S.O. 1990 authorizes municipalities to mandate sustainable urban design through site plan approvals. The Municipal Act recognizes municipalities as responsible local governments that have a broad range of powers; it details their roles and responsibilities. Recent updates to the Municipal Act and the City of Toronto Act have clarified the municipal authority to develop green-development standards. In Ontario, many local governments are using a "menu of metrics" approach that allows developers to pick and choose from a list of measures. The list includes performance-based measures, such as EnerGuide ratings, rather than prescriptive measures that dictate acceptable products and/or materials.

Numerous Ontario local governments already have sustainability strategies or green building policies, and many more are in the process of developing sustainability programs. A good number of them also require LEED® certification in new government buildings.

The City of Toronto first introduced the Toronto Green Standard in 2006. In 2017, the city developed its Zero Emissions Building Framework, with energy targets set to achieve zero emissions by 2050. It is currently implementing Version 3 of the Toronto Green Standard in new developments. In 2008, the cities of Vaughan, Brampton, and Richmond Hill together developed a set of sustainability metrics as a tool for achieving healthy, complete, and sustainable communities. The cities are currently reviewing their metrics to improve performance.

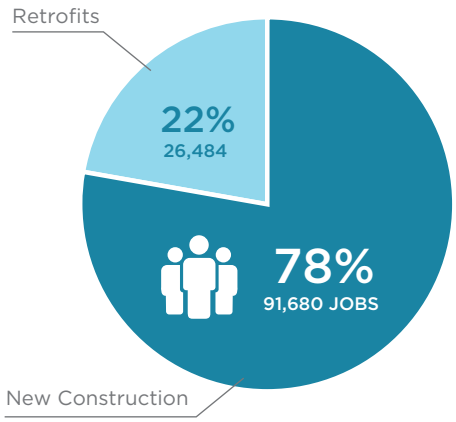
In 2010, the Town of Halton Hills developed a voluntary Green Development Evaluation Checklist, which later became a set of mandatory standards for new developments. The Town is actively identifying improvements to its Green Development Standard (GDS). The City of Mississauga has also implemented a voluntary GDS framework that focuses on Low Impact Development metrics; the city has aligned its GDS with its stormwater fee implementation, which increased uptake in the development community.[69]

Employment and GDP

In 2018, Ontario's green building sector employed 227,938 people – three per cent of the province's total workers – with 118,164 workers in the Construction and Trades sector, which in turn represented 23 per cent of the total construction sector. We estimate GDP at $22.7 billion. The retrofit economy employs 22 per cent of the province's green construction workforce in 26,484 jobs. When also considering indirect and induced employment, Ontario's green building industry offers 434,134 jobs and generates an estimated GDP of $43.7 billion.

Ontario hosts 43 per cent of Canada's Construction and Trades workforce – the largest single share of all provinces. However, the province may not top that list for long. Modelling conducted for this report points to a continuous contraction of Ontario's portion.

Figure 47: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Ontario, 2018)



69 Ibid.

We expect Ontario's construction sector will experience significant growth in the next decade. Should the provincial government opt to increase investment in green buildings and introduce progressive and supporting policy, by 2030 the green building sector could provide as many as 626,080 direct jobs and a GDP of $60.8 billion. Our Climate Forward scenario also assumes that the province will reach its greenhouse gas (GHG) targets.

The influence of green building certification is 64 per cent in Ontario for non-residential buildings. Green building construction jobs constitute 52 per cent of all green building jobs in Ontario.

Figure 48: Green Building Direct Jobs and GDP Forecast by Scenario (Ontario, 2030)

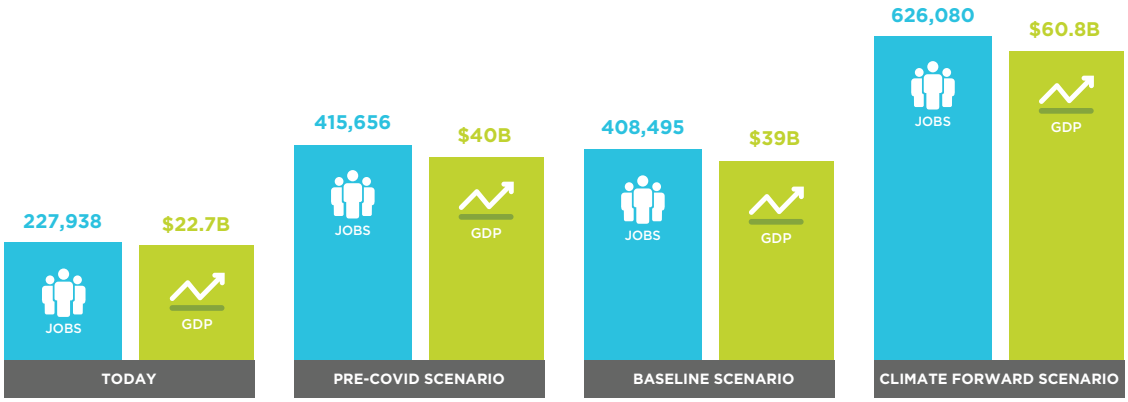
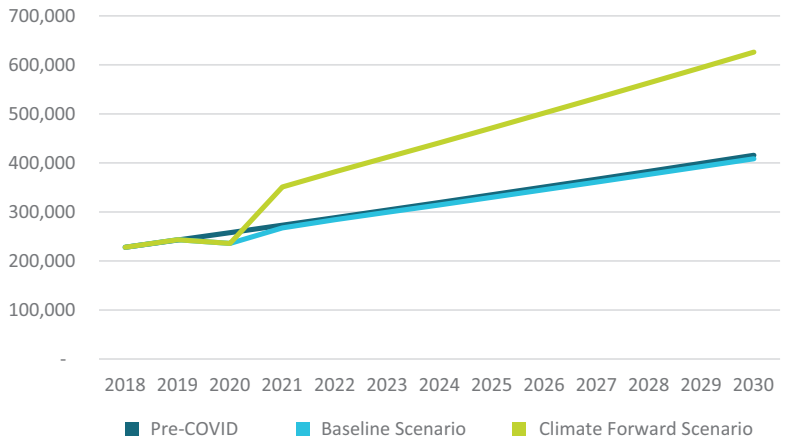


Figure 49: Green Building Direct Jobs Growth Forecast (Ontario, 2018-2030)



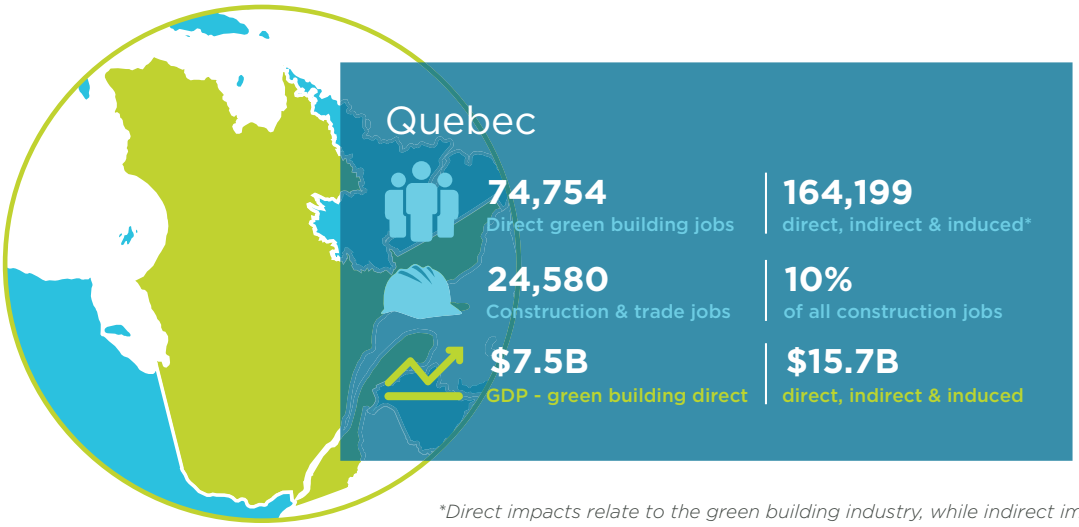
Quebec

Provincial Green Building Impact

Québec's culture of sustainability, climate change policy, and clean electrical grid have secured its reputation for leadership. However, the province is still missing some substantive policy and regulatory tools, including high-performance building codes, energy efficiency measures, and support for mass building electrification.

As of January 2020, Quebec has achieved 983 LEED® certifications – the most in Canada after Ontario. Further, between 2015 and 2019, 523 buildings achieved BOMA BEST® certification, 16 per cent of such certifications in Canada, the vast majority in Quebec and Montreal.

Figure 50: Green Building Industry (Quebec, 2018)



**Direct impacts relate to the green building industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct or indirect spending in the local economy outside of the green building industry (i.e. the economy as a whole).*

In addition to LEED® and BOMA BEST®, Quebec also offers the Novoclimat new-home certification, administered through Transition Energetique Quebec, a provincial agency. The agency certified more than 21,000 homes during Novoclimat's first iteration, between 1999 and 2013. In 2013, the province launched Novoclimat 2.0, which scaled up the program to achieve 15 per cent market penetration of new homes. Between 2015 and 2019, the agency certified 966 new homes under the program. About 2,000 homes are now built to the standard each year.

On energy efficiency, Quebec's current building code falls short of all iterations of the National Energy Code of Canada for Buildings. In fact, its commercial-institutional building code was last updated in 1983. Under the Transition Energetique Quebec (TEQ) Master Plan, the province committed to adopt the current version of that national model code by the end of 2020.

Local Green Building Impact

In 2018, the mayor of Montreal signed the Net Zero Carbon Buildings Declaration, an initiative of the C40 network. Signatories commit to ensure that all new buildings will operate at net zero carbon

by 2030, and pledge that all buildings will reach that goal by 2050. The city aims to reach carbon neutrality for all new buildings on city-owned land by 2030, and all existing buildings on city-owned land by 2050. The city is also steadily replacing oil heating systems in its buildings. It will phase in the removal of existing oil-heated furnaces and boilers in industrial, institutional and commercial buildings starting in 2025 and continue until 2030, when it will shift focus to homes.[70] Montreal requires all new municipal buildings to be certified LEED® Gold.

In 2008, the City of Québec spearheaded the Green and Intelligent Building Sector of Excellence, which brings manufacturers, technology providers, designers, and high-performance builders together under one roof. The city encourages developers to adopt LEED® in all new projects.[71]

Employment and GDP

In 2018, Quebec's green building sector employed 74,754 people, two per cent of the province's total employment, with 24,580 workers in the Construction and Trades sector, representing 10 per cent of the total construction sector and 33 per cent of all green building jobs. We estimate GDP at $7.5 billion. When also considering indirect and induced jobs, the province's green building industry offers 164,199 jobs and generates an estimated GDP of $15.7 billion. The retrofit economy employs 28 per cent of the province's green construction workforce in 6,798 jobs. The influence of green building certification is 61 per cent in Quebec for non-residential buildings.

Figure 51: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Quebec, 2018)

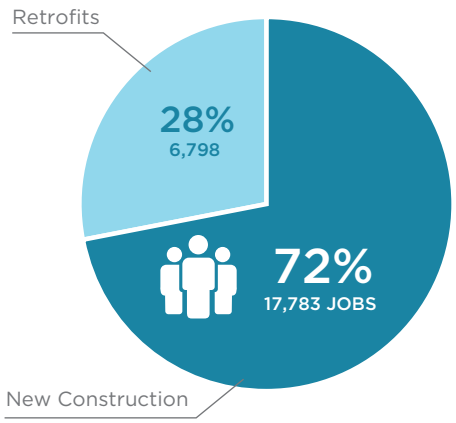
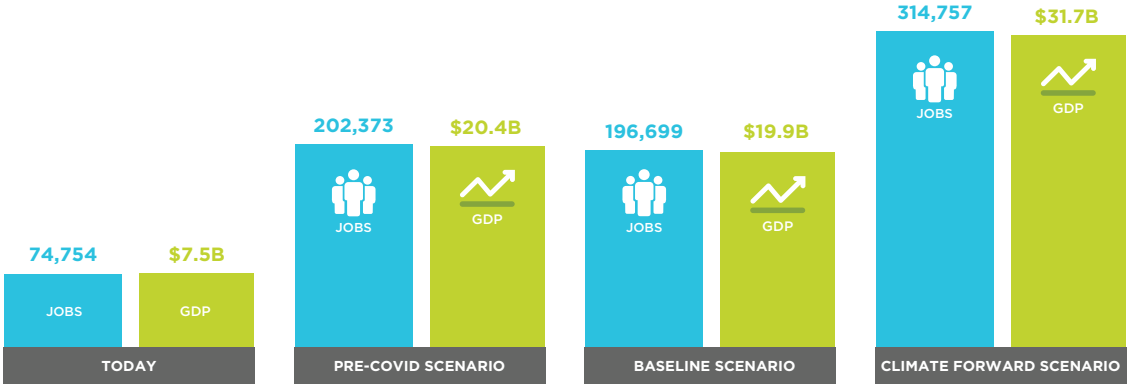


Figure 52: Green Building Direct Jobs and GDP Forecast by Scenario (Quebec, 2030)

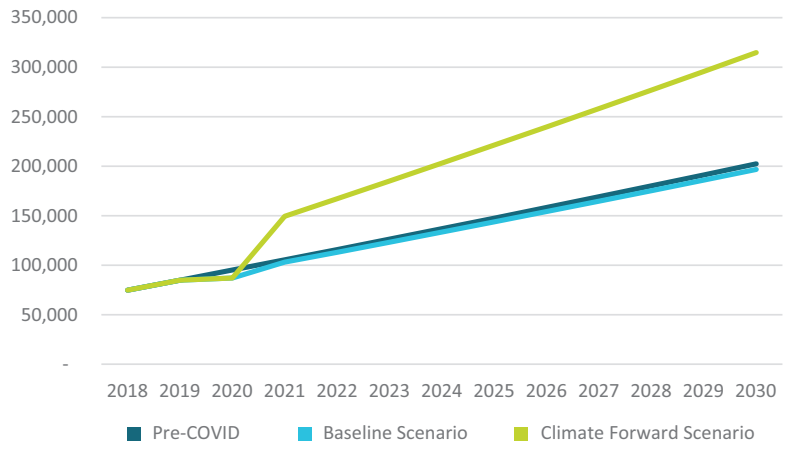


70 "The City of Montréal announces a first step towards carbon neutrality for its real estate assets." City of Montreal. EE Online. May 9, 2019. Retrieved from: https://electricenergyonline.com/article/energy/category/general/16/766509/the-city-of-montreal-announces-a-first-step-towards-carbon-neutrality-for-its-real-estate-assets.htm

71 "Québec City's unique approach to green and smart buildings." Québéc City Tourism. June 8, 2017. Retrieved from: https://meetings.quebec-cite.com/en/key-industries-quebec-city/quebec-approach-to-green-smart-buildings

In the next decade, we expect to see significant growth in Quebec's construction sector. Our Climate Forward Scenario assumes that the province will reach its greenhouse gas (GHG) targets. Should the provincial government update its building code and drive the electrification of buildings, by 2030 the green building sector could provide as many as 314,757 direct jobs and a GDP of $31.7 billion.

Figure 53: Green Building Direct Jobs Growth Forecast (Quebec, 2018-2030)



Nova Scotia

Provincial Green Building Impact

Nova Scotia's Department of Transportation and Infrastructure Renewal owns and operates the province's assets and oversees the design and construction of capital projects. In recent years, the department has been reviewing its green building policy as part of a planned update. Observers expect the updated policy will require a LEED® Silver certification on all provincially funded new buildings or major additions in urban areas (projects in lower density, rural areas would need to meet LEED® Certified). All public buildings would be subject to the rules, including schools, hospitals, court and corrections facilities, long term care facilities, and office buildings.[72] As of January 2020, the province had achieved 111 LEED® certifications. Further, between 2015 and 2019, 72 buildings achieved BOMA BEST® certification.

Nova Scotia's Sustainable Development Goals Act requires the province to reduce greenhouse gas (GHG) emissions 53 per cent below 2005 levels by 2030 and reach net zero by 2050. However, the legislation does not detail how the government will do so. Nova Scotia has adopted the National Energy Code of Canada for Buildings 2015 and is considering the 2020 iteration, which will aim for net-zero energy-ready construction.

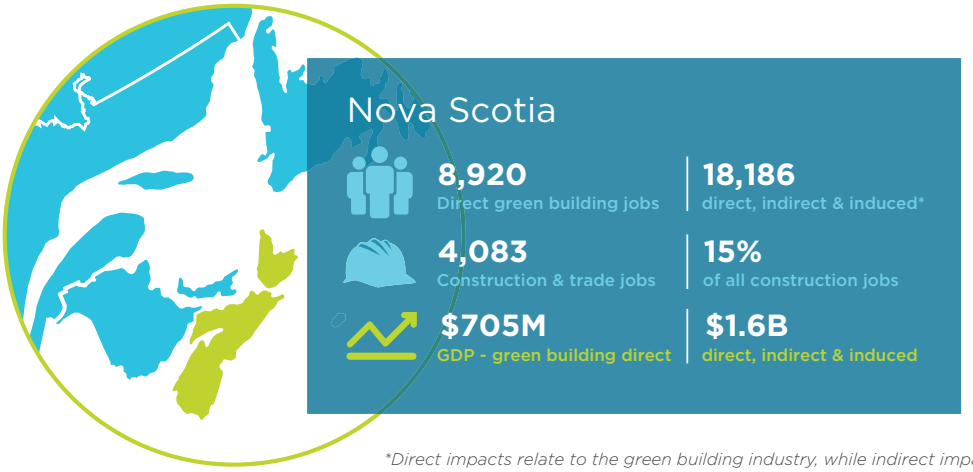
Efficiency Nova Scotia, Canada's first energy efficiency utility, offers rebates and financing to improve the energy efficiency of a building including upgrades such as heating systems, heat pumps, insulation, and water heating efficiency in homes and businesses across the province.

The province requires Nova Scotia Power, the province's privately-owned electric utility, to invest in energy efficiency when it is the most cost-effective option for ratepayers. As a result, Nova Scotians

72 The province may also consider alternative rating programs provided they demonstrate an acceptable LEED® equivalency in energy efficiency and water conservation and consumption.

invest about $35 million per year in energy efficiency. With the help of Nova Scotia Power, the Clean Foundation, and Efficiency Nova Scotia, since 2015 programs have invested $60 million for upgrades in more than 8,600 homes. The program supports homes that are heated by either electricity or oil.

Figure 54: Green Building Industry (Nova Scotia, 2018)



**Direct impacts relate to the green building industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct or indirect spending in the local economy outside of the green building industry (i.e. the economy as a whole).*

Local Green Building Impact

In 2019, the Halifax council declared a state of climate emergency for the city and set a target of net zero carbon by 2050. In June 2020, Halifax passed the HalifACT 2050: Acting on Climate Together Plan. The plan commits the community to reducing emissions, switching to clean and reliable energy sources, and demonstrating local government leadership.

On buildings, HalifACT 2050 commits to deep energy retrofits, electrification of home heating and hot water, implementing green building standards to reduce the GHG intensity of new buildings, and improving the efficiency of industrial processes. In 2016, fuel and electricity consumption in residential, commercial, and industrial buildings accounted for 70 per cent of all energy used in Halifax and 77 per cent of its total GHG emissions.

Halifax is targeting net-zero new construction by 2030 by developing, adopting, and applying a standard for net-zero and climate-resilient new construction. It also pledges to retrofit all existing buildings by 2040. The local government will deliver the programs with private homeowners, businesses, other levels of government, and industrial partners.[73]

Employment and GDP

In 2018, Nova Scotia's green building sector employed 8,920 people, which is two per cent of total employment, with 4,083 workers in the Construction and Trades sector. This represents 15 per cent of the total construction sector and 46 per cent of total green building jobs in the province.

73 "HalifACT 2050: Acting on Climate Together." Retrieved from: https://halifax.ca/sites/default/files/documents/about-the-city/energy-environment/HRM_HaliFACT_vIssued%20with%20Foreword.pdf

We estimate GDP at $705 million. The retrofit economy employs 25 per cent of the province's green construction workforce in 1,009 jobs. When also considering indirect and induced jobs, Nova Scotia's green building industry hosts 18,186 jobs and generates an estimated GDP of $1.6 billion. The influence of green building certification is 66 per cent in Nova Scotia for non-residential buildings.

In the next decade, we are expecting significant growth in Nova Scotia's construction sector. Our Climate Forward scenario assumes that the province will reach its GHG targets. Should the provincial government opt to increase investment in green buildings and introduce progressive and supporting policy, by 2030 the green building sector could provide as many as 31,406 direct jobs and a GDP of $2.7 billion.

Figure 55: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Nova Scotia, 2018)

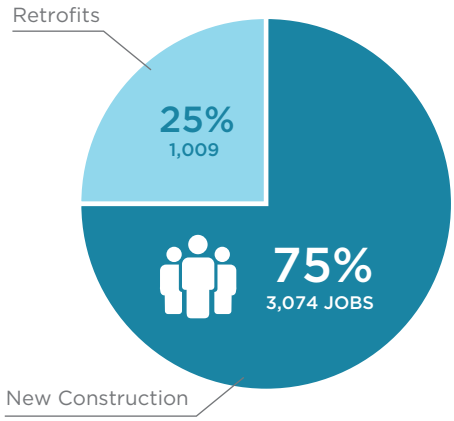


Figure 56: Green Building Direct Jobs and GDP Forecast by Scenario (Nova Scotia, 2030)

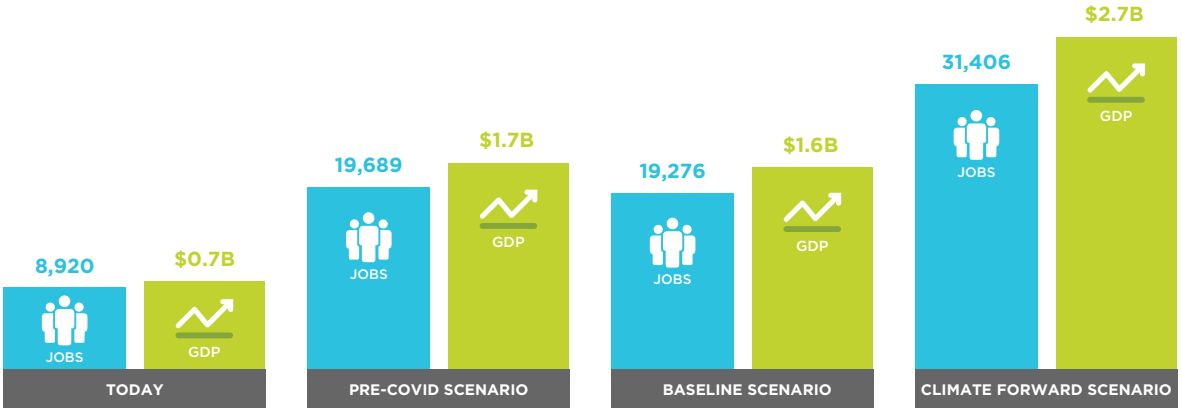
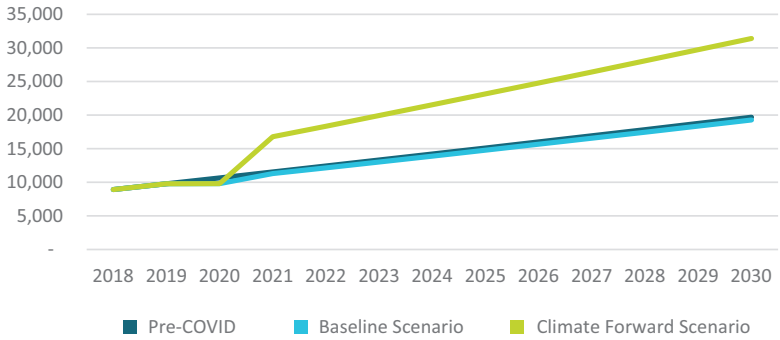


Figure 57: Green Building Direct Jobs Growth Forecast (Nova Scotia, 2018-2030)



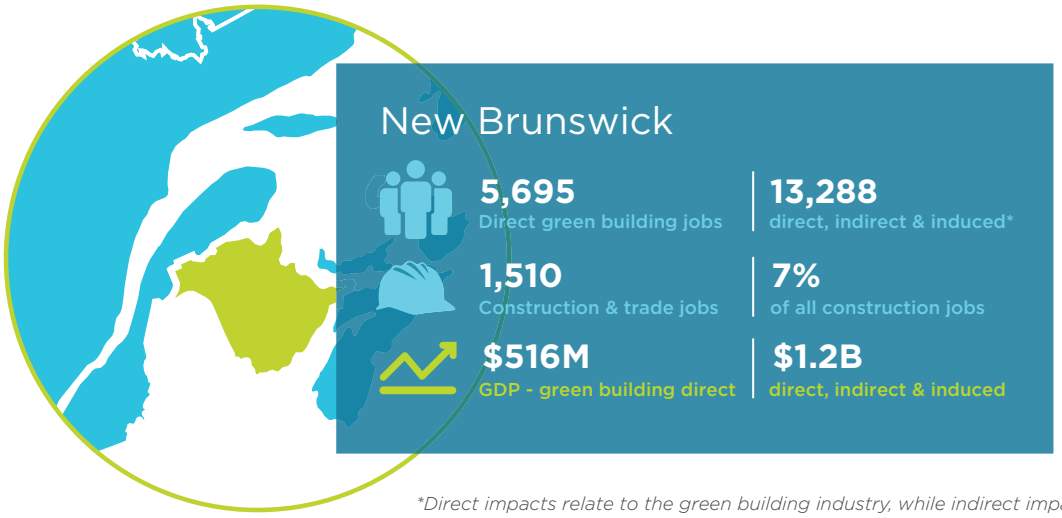
New Brunswick

Provincial Green Building Impact

New Brunswick's green building sector lags behind its Atlantic Canada peers; there is some investment in public infrastructure, but very little private development activity. The provincial government requires LEED® Certified, or an equivalency policy, in its new buildings. Through its Department of Transportation and Infrastructure, New Brunswick recently completed the first LEED® v4 project in Atlantic Canada, the King Street Elementary School in Mirimachi. The province was an early adopter of LEED®. As of January 2020, the province has achieved 34 LEED® certifications. Further, between 2015 and 2019, 46 buildings achieved BOMA BEST® certification.

New Brunswick aims to be carbon-neutral in its operations, facilities, and vehicles by 2030, and reduce emissions 10.7 Mt CO_2e by 2030. New Brunswick is aiming to introduce a Property Assessed Clean Energy (PACE) program, which would improve financing options for property owners pursuing energy efficiency and renewable energy improvements. The province also intends to introduce energy labelling for all residential and commercial new construction, and strengthen its Green Building Policy to include higher energy performance standards.

Figure 58: Green Building Industry (New Brunswick, 2018)



**Direct impacts relate to the green building industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct or indirect spending in the local economy outside of the green building industry (i.e. the economy as a whole).*

Local Green Building Impact

The City of Moncton's Green Building Policy requires all new buildings with a footprint larger than 500 m^2 to be built to LEED® Certified or Green Globes standards.

Employment and GDP

In 2018, the green building sector in New Brunswick employed 5,695 people, which is two per cent of total employment, with 1,510 workers in the Construction and Trades sector. This represents seven

per cent of the total construction sector and 27 per cent of total green building jobs in New Brunswick. We estimate GDP at $516 million. The retrofit economy employs 27 per cent of the province's green construction workforce in 407 direct jobs. When also considering indirect and induced jobs, the green building industry provides 13,288 jobs in New Brunswick and generates an estimated GDP of $1.2 billion.

The influence of green building certification is 48 per cent in New Brunswick for non-residential buildings.

In the next decade, New Brunswick could see growth in its construction sector if it leverages the green building industry to meet its GHG emission targets. Should the provincial government opt to increase investment in green buildings and introduce progressive and supporting policy, by 2030 the green building sector could provide as many as 27,506 direct green building jobs and a GDP of $2.6 billion.

Figure 59: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (New Brunswick, 2018)

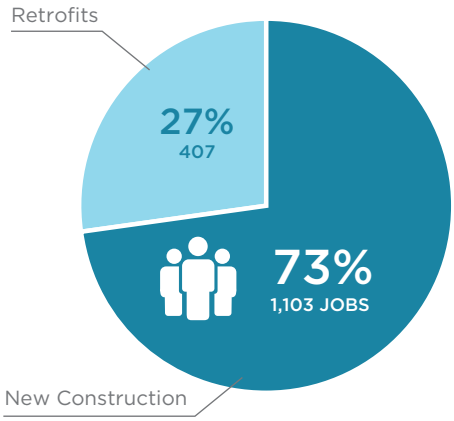


Figure 60: Green Building Direct Jobs and GDP Forecast by Scenario (New Brunswick, 2030)

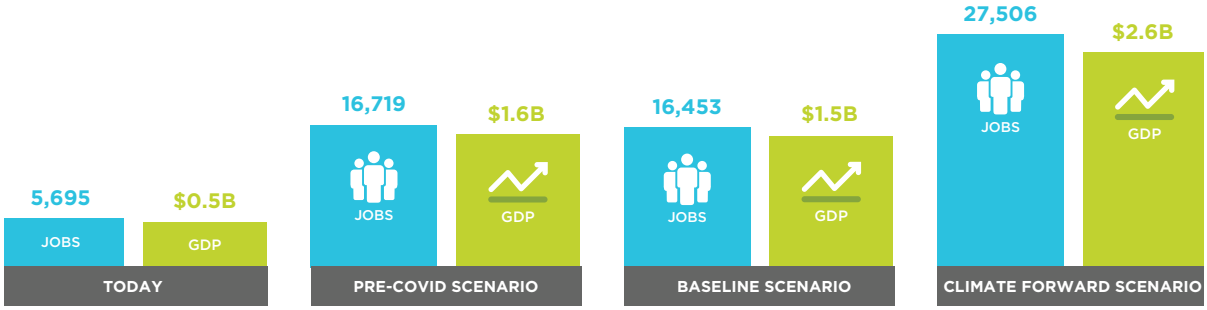
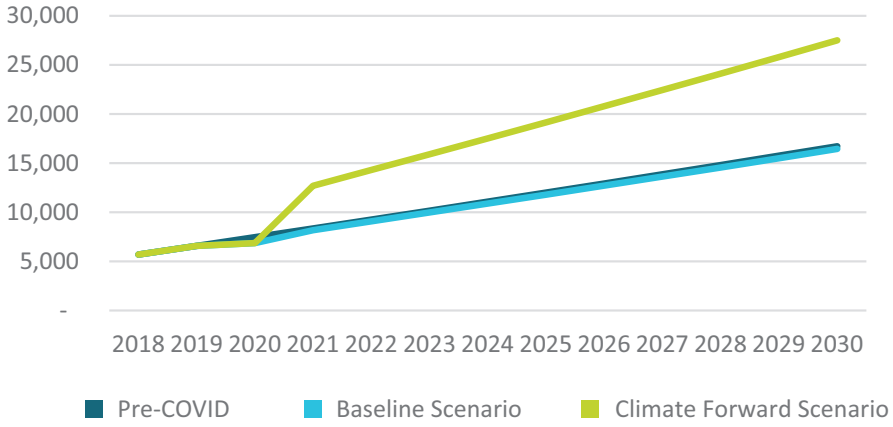


Figure 61: Green Building Direct Jobs Growth Forecast (New Brunswick, 2018-2030)



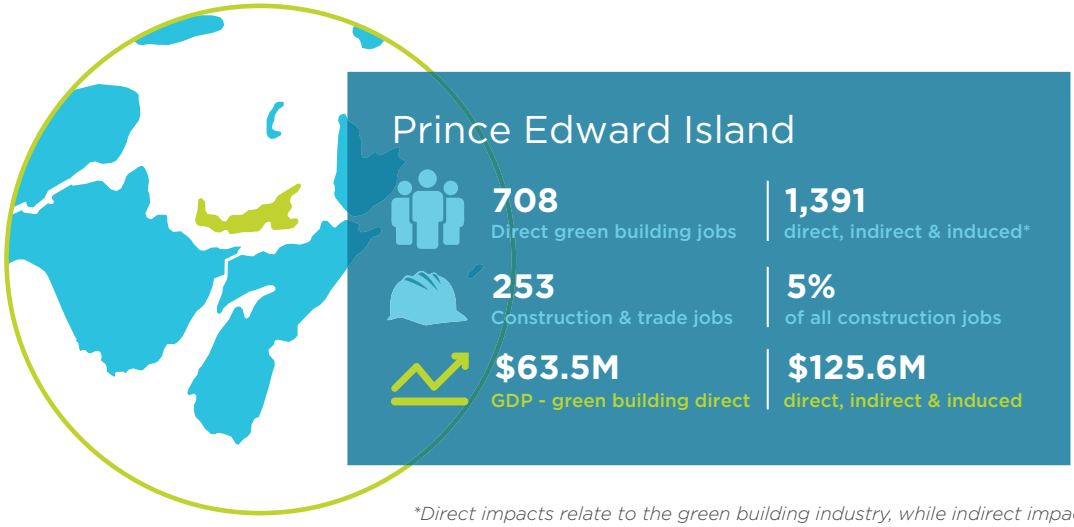
Prince Edward Island

Provincial Green Building Impact

Prince Edward Island's residential building sector is currently booming, which offers an opportunity to improve housing energy efficiency. In 2019, the provincial legislature passed a motion recommending new government buildings generate low to no emissions by meeting CaGBC's Zero Carbon Standard.

As of January 2020, the province has achieved six LEED® certifications. Further, between 2015 and 2019, three buildings achieved BOMA BEST® certification.

Figure 62: Green Building Industry (Prince Edward Island, 2018)



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Local Green Building Impact

The City of Charlottetown declared a climate emergency in 2019. Its Community Energy Plan, released that same year, committed the city to reduce greenhouse gas (GHG) emissions 50 to 65 per cent below 2015 levels by 2030 and lower GHGs in municipal operations 40 per cent by 2030 – while striving to achieve 100 per cent renewable energy and carbon neutrality by 2050 across all corporate operations.

Charlottetown's Community Energy Plan also committed the city to construct all new city buildings to meet Passive House and Zero Carbon Building Standards. The city will support Passive House and Zero Carbon multi-story affordable housing developments and create incentives for meeting the standards. The city will also work with stakeholders to boost industry capacity in support of its goal that all buildings will meet Passive House and Zero Carbon Building Standards by 2030.

Employment and GDP

In 2018, Prince Edward Island's green building sector employed 708 people, which is one per cent of total employment, with 253 workers in the green building Construction and Trades sector. This

represents five per cent of the total construction sector and 36 per cent of total green building jobs in PEI. We estimate GDP at $63.5 million. The retrofit economy employs 23 per cent of the province's green construction workforce in 57 jobs.

When also considering indirect and induced jobs, the province's green building industry offers 1,391 jobs and generates an estimated GDP of $125.6 million. The influence of green building certification is less than half a per cent (0.3) in PEI for non-residential buildings.

In the next decade, PEI could see growth in the construction sector if it leverages the green building industry to meet its GHG emission targets. Should the provincial government opt to increase investment in green buildings and introduce progressive and supporting policy, by 2030 the green building sector could provide as many as 4,901 direct jobs and a GDP of $490 million.

Figure 63: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Prince Edward Island, 2018)

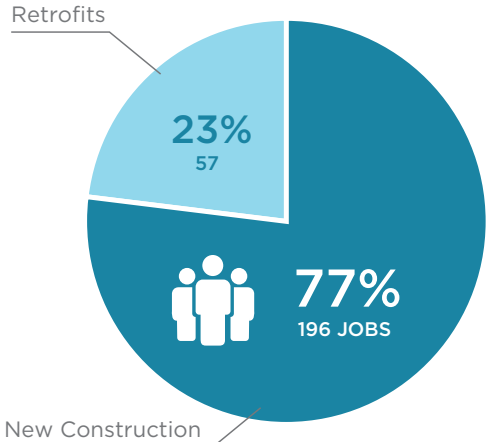


Figure 64: Green Building Direct Jobs and GDP Forecast by Scenario (Prince Edward Island, 2030)

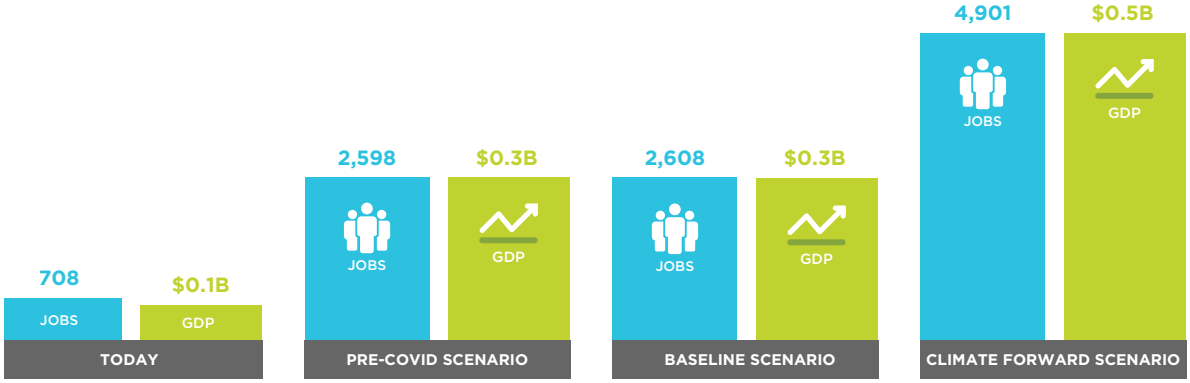
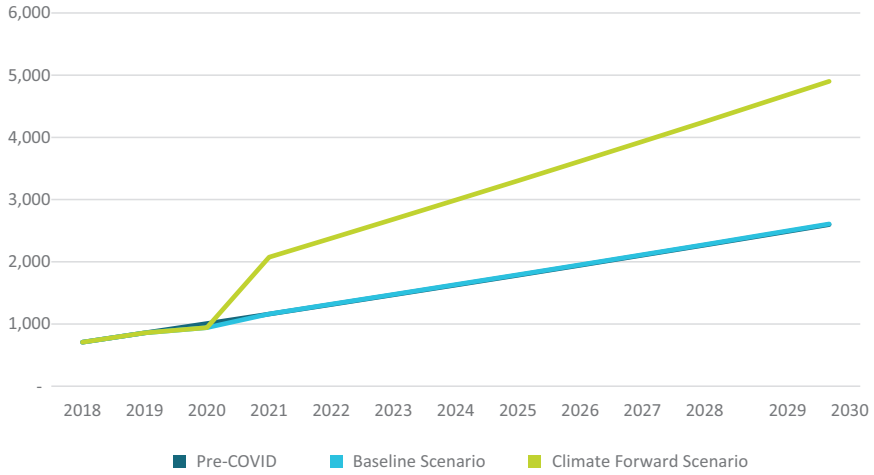


Figure 65: Green Building Direct Jobs Growth Forecast (Prince Edward Island, 2018-2030)

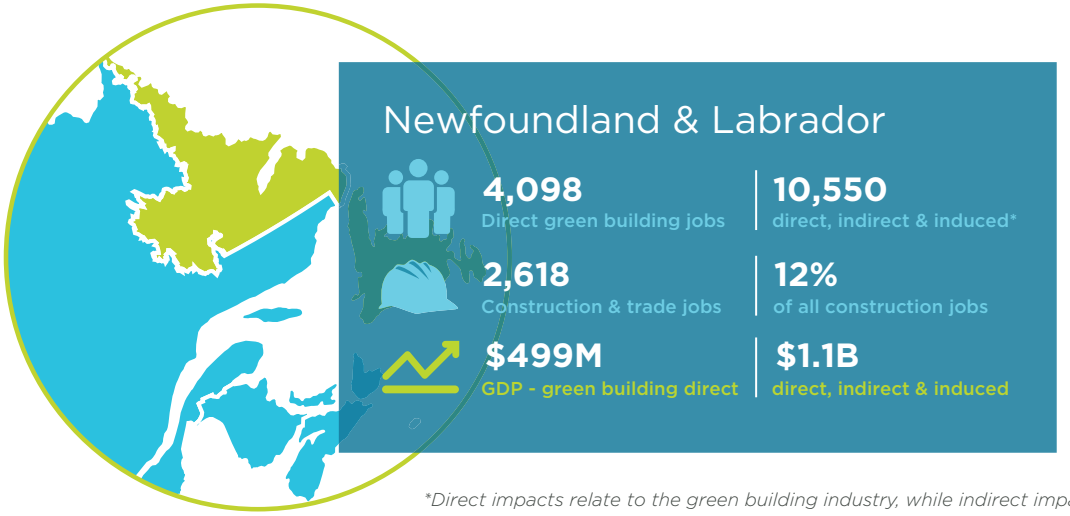


Newfoundland and Labrador

Provincial Green Building Impact

In keeping with the Government of Canada's climate target, the Government of Newfoundland and Labrador is striving to reduce provincial greenhouse gas (GHG) emissions 30 per cent below 2005 levels by 2030. The province's Climate Plan requires provincially funded new buildings to reach high energy efficiency and environmental standards and establishes minimum energy-efficiency requirements for commercial and institutional buildings. The provincial government owns or leases more than 1,000 buildings and structures. As of January 2020, the province had achieved 32 LEED® certifications. Further, between 2015 and 2019, 12 buildings achieved BOMA BEST® certification.

Figure 66: Green Building Industry (Newfoundland and Labrador, 2018)



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In its 2019 Energy Efficiency Policy Scorecard, Efficiency Canada ranked Newfoundland and Labrador in last place among all provinces. The national think tank cited the province's lack of policy on a range of metrics, from promoting electric vehicle adoption to improving construction codes.[74] Newfoundland and Labrador lacks a provincial building code, and the province has yet to commit to adopting net-zero energy-ready codes.

Shortly after Efficiency Canada released its scorecard, the province introduced a $1 million Heat Pump Rebate Program. Under the pilot, up to 1,000 homeowners can receive $1,000 toward the purchase of a heat pump.[75] However, even without that program in place, since 2017 heat pump sales have skyrocketed in the province – most likely due to escalating power and energy costs. As the Muskrat Falls hydroelectric project comes online following extensive delays and cost overruns, customer power rates will inevitably rise to pay for it.[76]

74 Bird, Lindsay. "N.L. lags behind Canada in energy efficiency, but there's a silver lining to the stats." CBC News. November 25, 2019. Retrieved from: https://cbc.ca/news/canada/newfoundland-labrador/energy-efficiency-scorecard-newfoundland-labrador-1.5367900

75 "Heat Pump Rebate Pilot Program to Begin Accepting Applications." (Press release.) Ministry of Municipal Affairs and Environment. Province of Newfoundland and Labrador. Retrieved from: https://gov.nl.ca/releases/2019/mae/1009n05/

76 Maher, David. "Cost and schedule for Muskrat Falls project expands yet again." The Telegram. May 26 2020. Retrieved from:

Local Green Building Impact

On the municipal side, in November 2019 the City of St. John's declared a climate emergency and a month later its mayor joined the Global Covenant of Mayors. Apart from that, the province's Municipalities Act requires municipal councils to adopt "the National Building Code of Canada and supplements or amendments to that Code." This would include future revisions.

Employment and GDP

In 2018, Newfoundland and Labrador's green building sector employed 4,098 people, which is two per cent of total employment, with 2,618 workers in the green building Construction and Trades sector. This represents 12 per cent of the total construction sector and 64 per cent of total green building jobs in the province. We estimate GDP at $63.5 million. The retrofit economy employs 26 per cent of the province's green construction workforce in 692 direct jobs. When also considering indirect and induced jobs, the green building industry offers 10,550 jobs in Newfoundland and Labrador and generates an estimated GDP of $1.1 billion.

Figure 67: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Newfoundland and Labrador, 2018)

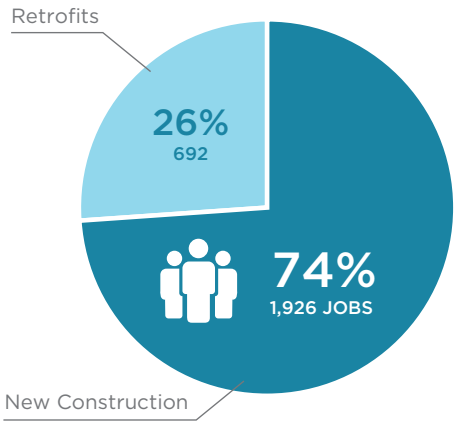
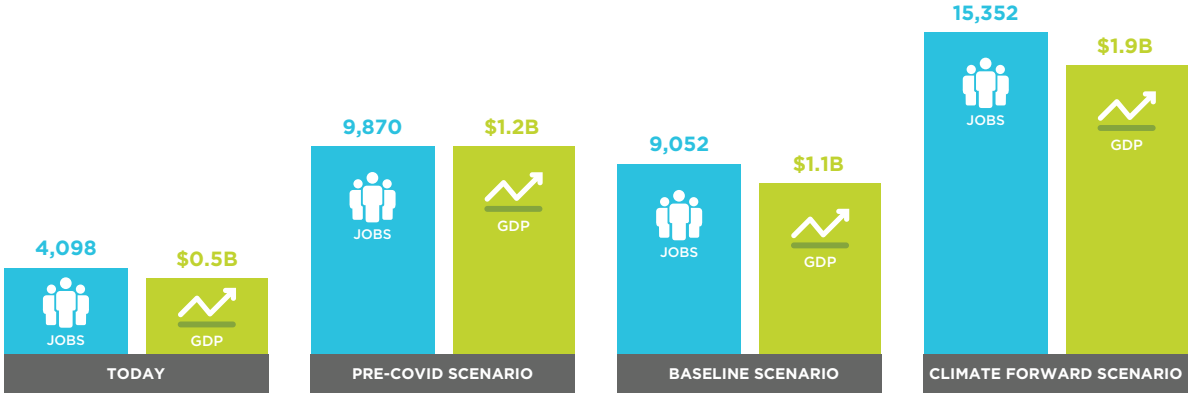


Figure 68: Green Building Direct Jobs and GDP Forecast by Scenario (Newfoundland and Labrador, 2030)

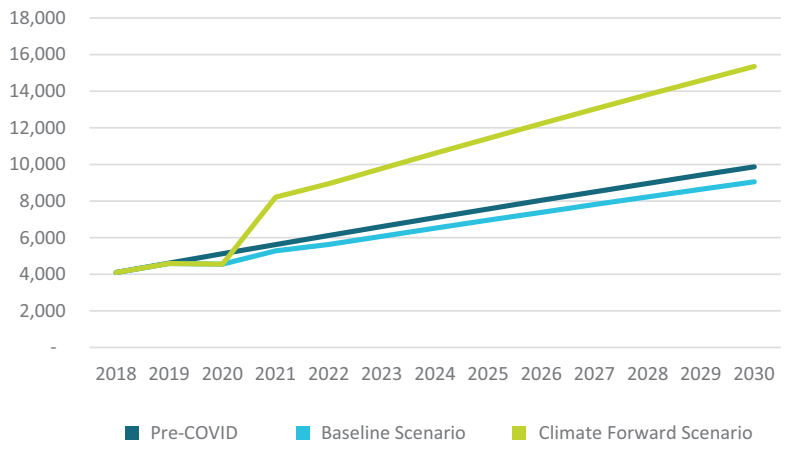


In the next decade, we expect to see significant growth in the Newfoundland and Labrador construction sector. Our Climate Forward scenario assumes that the province will reach its GHG targets. Should the provincial government opt to increase investment in green buildings and introduce progressive and supporting policy, by 2030 the green building sector could provide as many as 4,901 direct jobs and a GDP of $490 million.

https://thetelegram.com/news/local/cost-and-schedule-for-muskrat-falls-project-expands-yet-again-454205/

The influence of green building certification is less than half a per cent (0.3) in Newfoundland and Labrador for non-residential buildings.

Figure 69: Green Building Direct Jobs Growth Forecast (Newfoundland and Labrador, 2018-2030)



The Yukon Territory

Territorial Green Building Impact

Recent Environment and Climate Change Canada research concludes that temperatures in the Yukon Territory have risen at a faster rate than those in the rest of the country and confirms that the region is especially vulnerable to significant and widespread impacts.[77] As of January 2020, the territory had achieved five LEED® certifications. Further, between 2015 and 2019, one building achieved BOMA BEST® certification.

In late 2019, the Government of the Yukon partnered with Yukon First Nations, transboundary Indigenous groups, and Yukon local governments to produce Our Clean Future, a climate change, energy, and green economy discussion paper.[78] The draft plan seeks to reduce Yukon's greenhouse (GHG) emissions 30 per cent below 2010 levels by 2030. The Government of Yukon pledges to invest $30 million, on average, each year for energy efficiency improvements to homes and buildings. This will include low-interest financing and rebates, support for Yukon First Nations, and municipal governments.

The Government of Yukon is leading by example by committing to retrofit and install renewable heating systems in Government of Yukon buildings, which the territory expects will reduce GHG emissions eight kilotonnes by 2030.

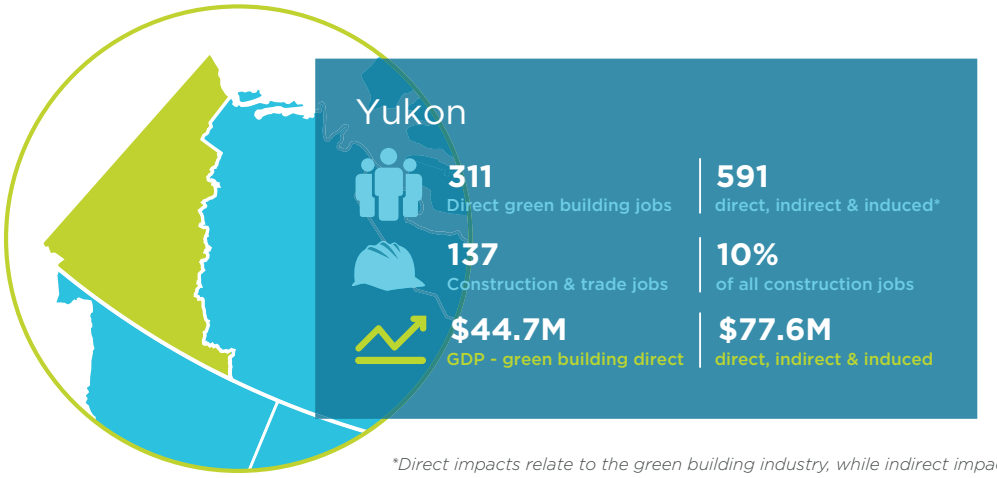
Heating accounts for 18 per cent of the Yukon's annual GHG emissions, which creates an opportunity for green buildings. Its Department of Highways and Public Works is developing a best practices manual to increase the energy efficiency of new buildings. Our Clean Future also proposes heating large commercial and government buildings with sustainably sourced biomass. The fuel is a low-carbon and renewable energy source that can help reduce GHG emissions while supporting local

77 "Report of the Auditor General of Canada to the Yukon Legislative Assembly." Office of the Auditor General of Canada. December 2017. Retrieved from: https://oag-bvg.gc.ca/internet/English/yuk_201712_e_42706.html

78 "Our Clean Future: A Yukon strategy for climate change, energy and a green economy - Draft for Public Review." Yukon Territory. November 2019. Retrieved from: https://yukon.ca/sites/yukon.ca/files/env/env-our-clean-future-draft.pdf

jobs and lowering the risk of forest fires around Yukon communities. The paper also focusses on efficient electric heating technologies such as air-source and ground-source heat pumps.[79]

Figure 70: Green Building Industry (Yukon, 2018)



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In recent years, the government has built several exceptionally energy efficient buildings, including the Tombstone Interpretive Centre, Whitehorse Correctional Centre, Whitehorse Emergency Response Centre, and the new F.H. Collins Secondary School. The Yukon government has also progressed on implementing the Residential Energy Incentives Program and the Commercial Energy Incentive Program to help building owners improve energy performance and reduce emissions.[80]

The Yukon aims to reduce the emissions intensity of existing residential, commercial, and institutional buildings five per cent by 2020 and reduce the emission intensity of on-grid diesel power generation by 20 per cent by the same year. Its gradual movement to green building is helping it reach those targets ahead of schedule.

Local Green Building Impact

The City of Whitehorse now requires an EnerGuide Rating System label on new homes. The city's Building and Plumbing Bylaw specifies minimum insulation levels, airtightness ratings, and more.[81] All commercial construction must adhere to the current edition of the National Building Code of Canada for Buildings or the National Energy Code of Canada for Buildings.

79 Ibid.

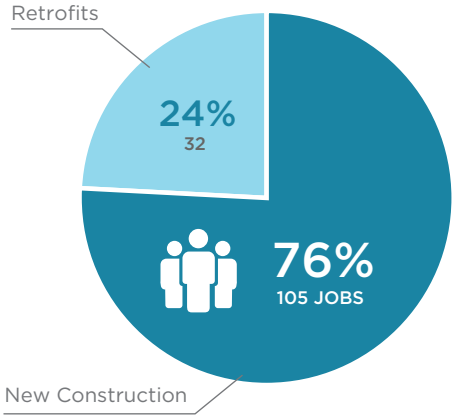
80 "Greenhouse Gas Emissions in Yukon." Yukon Territory. February 17, 2020. Retrieved from: https://yukon.ca/en/greenhouse-gas-emissions-yukon

81 "City of Whitehorse Green Building Standards." City of Whitehorse. Retreived from: https://whitehorse.ca/departments/planning-building-services/building-inspections/new-green-building-standards

Employment and GDP

With construction and maintenance work expected to increase in the coming decade, a stepped-up green building commitment could help the Yukon create jobs and achieve its climate targets. This is occurring while industry grapples with responses to the anticipated retirement of more than one quarter of a million skilled workers over the coming decade. The Northwest Territories, Yukon Territory, and Nunavut will all likely face increased competition for qualified workers due to strong labour demand in British Columbia and peak maintenance demands in Alberta.

Figure 71: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Yukon, 2018)



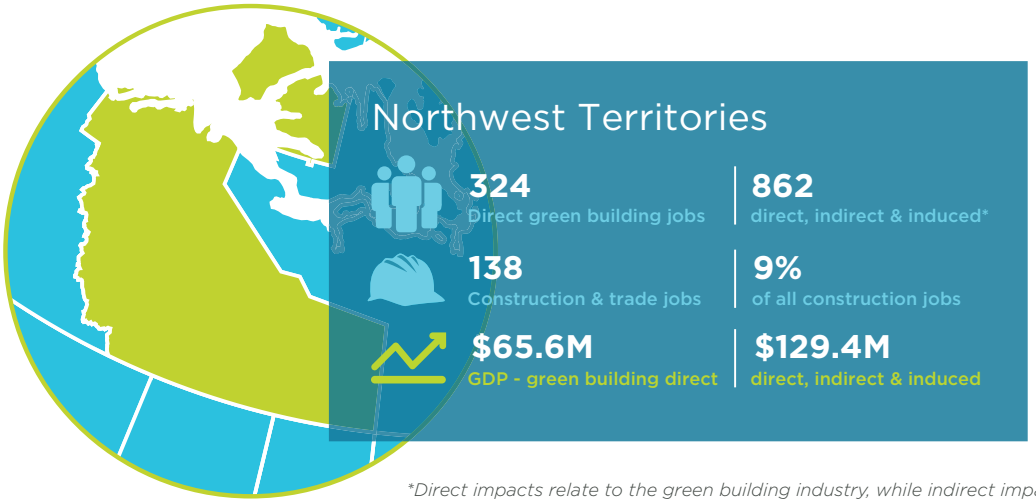
In 2018, the Yukon's green building sector employed 311 people directly, two per cent of total employment, with 137 workers in the green building Construction and Trades sector. This represents 10 per cent of the total construction sector and 44 per cent of all green building jobs in the territory. We estimate GDP at $44.7 million. The retrofit economy employs 24 per cent of the green construction workforce in 32 jobs. When we consider indirect and induced jobs, the green building industry offers 591 jobs in the Yukon and generates an estimated GDP of $77.6 million. The influence of green building certification is 36 per cent in the Yukon for non-residential buildings.

Northwest Territories

Territorial Green Building Impact

The 2030 Government of the Northwest Territories (NWT) Climate Change Strategic Framework seeks to reduce greenhouse gas (GHG) emissions 30 per cent below 2005 levels by 2030, increase understanding of local climate change impacts, and build resilience and bolster adaptation work.

Figure 72: Green Building Industry (Northwest Territories, 2018)



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In 2018, the NWT released the first of two five-year Action Plans to support the 2030 NWT Climate Change Strategic Framework. It will report annually on its progress.[82]

The NWT's 2030 Energy Strategy aims to reduce GHG emissions from diesel electricity generation by an average of 25 per cent while increasing the share of renewable energy used for space heating by 40 per cent. Residential, commercial, and government building energy efficiency must improve 15 per cent by 2030.[83]

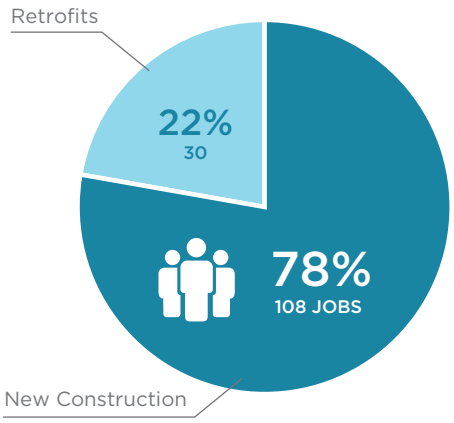
Building above the Arctic Circle presents its own unique set of challenges. In 2005, the NWT and Government of Nunavut published Good Building Practice for Northern Facilities. The document offers guidance, without compliance requirements, to building professionals, contractors, suppliers, facility administrators, and operators. As of January 2020, the territory has achieved two LEED® certifications. Further, between 2015 and 2019, seven buildings achieved BOMA BEST® certification.

Local Green Building Impact

The City of Yellowknife requires LEED® Certified on all new municipal buildings. All commercial buildings must be at least 25 per cent more energy efficient than the National Model Energy Code of Canada for Buildings (1997).

Ecology North and Yellowknife's Dene First Nation have partnered on the four-storey Northern Centre for Sustainability, now under construction in Yellowknife. The team is targeting the International Living Future Institute's Living Building Challenge certification. Its proponents hope it will be carbon-negative and energy, water, waste, and people-positive. It will be the first project of its kind in the North. The industry capacity boost from this project – together with enabling policy – positions NWT well to actively advance green building construction.

Figure 73: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Northwest Territories, 2018)



Employment and GDP

In 2018, the Northwest Territories' green building sector employed 324 people directly, which is two per cent of total employment, with 138 workers in the green building Construction and Trades sector. This represents nine per cent of the total construction sector and 42 per cent of all green building jobs in the Northwest Territories. We estimate GDP at $65.6 million. The retrofit economy employs 22 per cent of the province's green construction workforce in 30 direct jobs. When also considering indirect and induced jobs, the green building industry offers 862 jobs in the Northwest Territories and generates an estimated GDP of $129.4 million.

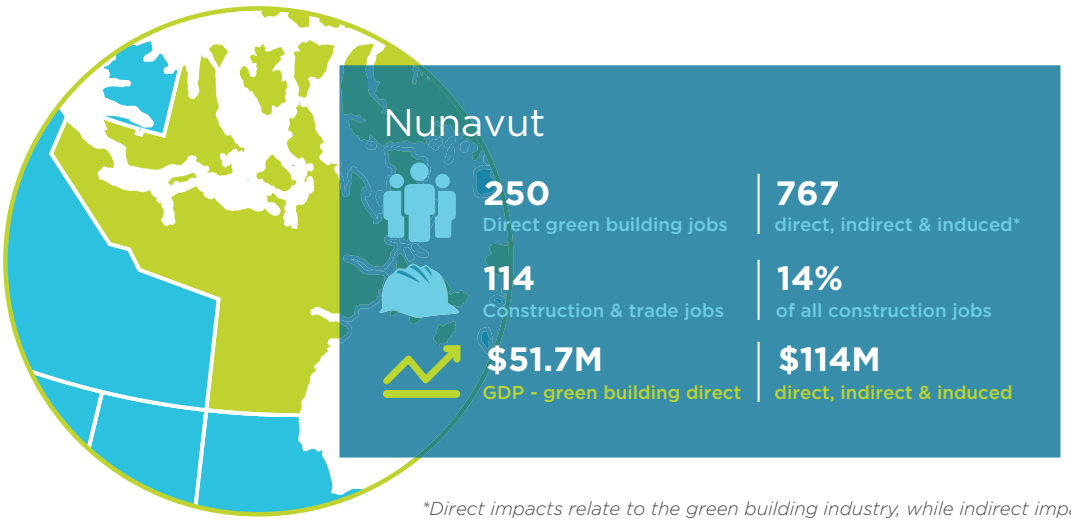
82 "2030 NWT Climate Change Strategic Framework." Government of the Northwest Territories. Retrieved from: https://enr.gov.nt.ca/en/services/climate-change/2030-nwt-climate-change-strategic-framework; "2030 NWT Climate Change Strategic Framework - 2019-2023 Action Plan." Government of the Northwest Territories. Retrieved from: https://enr.gov.nt.ca/sites/enr/files/resources/128-climate_change_ap_proof.pdf

83 "2030 Energy Strategy." Government of the Northwest Territories. Retrieved from https://inf.gov.nt.ca/en/services/energy/2030-energy-strategy

Nunavut

The territory of Nunavut relies heavily on fossil fuels for its energy use. Currently, electricity in Nunavut is produced primarily through diesel combustion with some small renewable projects and applications starting to emerge including wind, hydro, and residual heat. Solar applications have demonstrated success in Nunavut, namely the solar photovoltaic installation at Iqaluit's Arctic College, which the institution commissioned in 1995.

Figure 74: Green Building Industry (Nunavut, 2018)

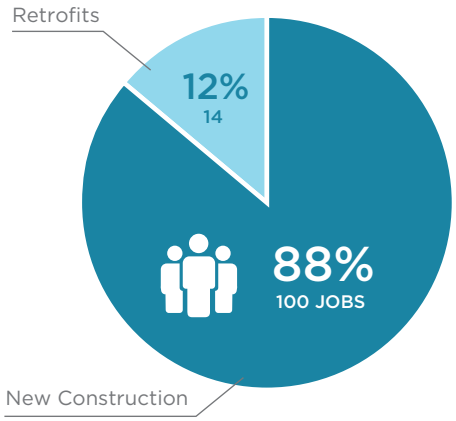


**Direct impacts relate to the green building industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct or indirect spending in the local economy outside of the green building industry (i.e. the economy as a whole).*

In 2007, Ikummatiit: An Energy Strategy for Nunavut came into effect and provided information and insights for Nunavut's energy policies and related government programs. It aims to create an energy system that is affordable, sustainable, reliable, and environmentally responsible, and to provide business and employment opportunities as the territory increases energy efficiency and uses renewable and domestic energy sources.[84]

Building above the Arctic Circle presents its own unique set of challenges. In 2005, Nunavut partnered with the Northwest Territories to publish Good Building Practice for Northern Facilities. The document offers guidance, without compliance requirements, to building professionals, contractors, suppliers, facility administrators, and operators.

Figure 75: Direct Jobs in Green Building Construction and Trades in Renovation and New Construction (Nunavut, 2018)



84 "Ikummatiit Energy Strategy." Government of Nunavut. September 2007. Retrieved from: https://gov.nu.ca/sites/default/files/ikummatiit_energy_strategy_english.pdf

Green building is emerging in Nunavut, with a number of projects in recent years receiving LEED® certifications, including the Iqaluit International Airport Improvement Project and the Canadian High Arctic Research Station.[85]

In 2018, the green building sector in Nunavut employed 250 people directly, which is two per cent of total employment, with 114 workers in the green building Construction and Trades sector, representing 14 per cent of the total construction sector and 46 per cent of total green building jobs in the territory. We estimate green building related GDP at $51.7 million. The retrofit economy employs 12 per cent of the province's green construction workforce in 14 jobs. When also considering indirect and induced jobs, the green building industry offers 767 jobs in Nunavut and generates an estimated GDP of $114 million. The influence of green building certification is 68 per cent in Nunavut for non-residential buildings.

85 "Good Building Practices Guideline – Second Edition." Government of Nunavut. December 2005. Retrieved from https://gov.nu.ca/sites/default/files/good_building_practices_guideline.pdf

PART D

Opportunities for Accelerating Green Building

In this section, we outline a series of social, technological, scientific, and economic trends and drivers that we anticipate will accelerate market transformation in the coming decade. In each case, we present examples of – and evidence for – the trend or driver, then ground it in the broader context of the green building industry. Some of these phenomena represent unresolved challenges for the sector, while we expect others will catalyze rapid change. All of them will drive industry to continually improve and elevate the bar of performance while steadily greening Canada's communities, one building at a time.

If you feel we've overlooked an important trend, please let us know! Tweet us at **@CaGBC** or drop a note to **info@CaGBC.org**.

Healthy, Equitable, and Inclusive Buildings

In recent years, the green building industry has largely focused on energy efficiency and carbon. But green buildings are capable of delivering many more benefits, and we already see more attention paid to social sustainability factors and, in this COVID-19 era, health.

Buildings impact human health at both the individual scale, in the form of indoor air quality from in-building sources of pollution, and the societal scale, from the impacts of the production and distribution of the energy that powers them. At the individual level, indoor air filtering and purification has jumped up the list of concerns under the COVID-19 pandemic. Canadians spend a great deal of time indoors, which exposes us to many indoor pollutants and, potentially, airborne droplets carrying the Novel Coronavirus.[86] Through thoughtful equipment and materials selection, green buildings either reduce or eliminate a range of indoor pollutants and contaminants, including volatile organic compounds, formaldehyde, allergens, environmental tobacco smoke, nitrogen dioxide, and fine particulates. We can improve health – and especially the health of those with existing chronic conditions – by reducing or outright eliminating these contaminants.

Green buildings also encourage better physical and mental health. Research has demonstrated that they improve productivity, lower employee turnover, and lower the length of open staff positions.[87] Every year, more new homes are built with better indoor air quality.

Health is not the only social sustainability factor influenced by buildings. The very fabric of today's built environment is woven with inequity. From the green building movement's earliest days, its leaders defined the concept of sustainability as a balance between environmental, social, and economic considerations. This triple-bottom-line approach seeks comprehensive solutions that support the quality of life for all. In addition to natural and economic capital, green building projects

86 Allen, J.G., MacNaughton, P., Laurent, J.G.C. et al. 2015. Green Buildings and Health. Curr Envir Health Rpt 2, 250–258 (2015). Retrieved from: https://doi.org/10.1007/s40572-015-0063-y

87 Ibid.

consider social capital. This is a calculation of the costs and benefits to the people who design, construct, live in, work in, and constitute the local community, and those whom a project will influence, either directly or indirectly.

In practice, planners, architects, designers, and construction companies have long struggled to embrace and implement social sustainability.[88] But at its core, it is about ensuring buildings and communities create value for all stakeholders, not just a select few. For example, an energy-efficient building that saves the owner money, but sickens its occupants, is not sustainable. Similarly, a material that boasts a small carbon footprint, but was made in a sweatshop, does not make the grade. Ditto an eco-resort that features rooftop solar panels, but which displaced local people and/or threatened species in its development.[89]

Despite having owned up to the problem decades ago, the green building movement still struggles to address social needs. This has led to social sustainability blind spots, and as a result, many projects have, in the past, underperformed on equity, diversity, and inclusion (EDI). There have been some recent attempts to address this. A set of LEED® pilot credits – Social Equity within the Community, Social Equity within the Project Team, and Social Equity within the Supply Chain – incentivize EDI measures in the building industry. Further, some architecture and design firms are collaborating with advocacy and front-line organizations to develop best practices for hard-wiring EDI into proposed projects – and working to get this guidance into broad circulation.[90]

As these efforts pay off, we expect that green buildings will, in the coming years, more consistently and reliably support social outcomes and genuinely welcome everyone.

Implications for the green building industry

Architects and engineers pay close attention to indoor air quality through carefully specified ventilation systems, and COVID-19 has thrown a spotlight on this critical equipment. As builders pay more attention to airtightness in pursuit of strict energy performance targets, they must also ensure adequate ventilation and abundant fresh, filtered outside air.

Designers and product manufacturers will increasingly source and develop building products and finishings with Health Product Declarations (HPDs). These disclose potential chemicals of concern in products by comparing ingredients with a set of priority "hazard" lists in turn based on the GreenScreen for Safer Chemicals, as well as other lists from government agencies. HPDs qualify for numerous green building certifications, including LEED® v4 and the WELL Building Standard, managed by the International Well Buildings Institute.

The green building industry is already addressing equity, diversity and inclusion (EDI) by adjusting hiring practices, championing education and training for existing staff, and benchmarking progress. The International Living Future Institute's JUST™ label, a transparency program focused on social justice in the workplace, is already changing perceptions and practices to measure and improve workplace EDI.

88 "Getting Beyond Green: A baseline of equity approaches in sustainable building standards." July 2019. NAACP (National Association for the Advancement of Colored People). Retrieved from: https://naacp.org/wp-content/uploads/2020/04/CESBS-Equity-Baseline-for-Building-Standards_July-2019.pdf

89 Knox, Nora. "What is green building?" U.S. Green Building Council. February 18, 2015. Retrieved from: https://usgbc.org/articles/what-green-building-0

90 For example, see "Designing for Inclusivity: Strategies for Universal Washrooms and Change Rooms in Community and Recreation Facilities." HCMA Architecture + Design. March 27, 2018. Retrieved from https://hcma.ca/designing-for-inclusivity

Climate Change and Adaptation

Green buildings will play a leading role in both reducing GHG emissions and responding to the new challenges of a warming world.

First and foremost, new and retrofitted buildings must burn little to no fossil fuel. Homes, offices, schools, and other buildings will need to take full advantage of passive strategies such as more effective insulation, improved airtightness, and greater thermal mass. Builders and developers will also need to access solar energy and other renewable inputs. They will look to new technologies and strategies to both reduce energy use and cut the energy required to build their projects – including the carbon and energy embodied in building materials.[91]

Canada's buildings will also play a role in responding to – and recovering from – the impacts of climate change. Climate scientists expect that in the coming decades, extreme storms and other events and conditions, such as heavily degraded air quality, will increasingly become a fact of life. The previous generation of designers, architects, and engineers could not have anticipated our current reality and did not design buildings to address these conditions. New, more future-proof buildings will need to keep cool through summer heatwaves, protect their occupants from extreme wind and rain, and resist potential structural damage from soil subsidence. The boundaries of flood-prone areas will widen, requiring defensive measures to protect buildings from rising waters and strategies to ensure they "bounce back" more quickly once those waters recede.

Climate change is already transforming the way architects, engineers, and the trades design, build, and operate buildings; all are now paying greater attention to operational energy and emissions and the impacts of extreme weather.

Following the more than 500 climate emergency declarations now in place across Canada,[92] many local governments are rolling out action plans that target the built environment with policy. All levels of government are accelerating more stringent building codes and implementing energy-efficient and low- to zero-carbon building regulations. Existing buildings are also getting fresh attention; several jurisdictions are now working on developing retrofit codes.

Implications for the green building industry

Climate change is already transforming the way architects, engineers, and the trades design, build, and operate buildings; all are now paying greater attention to operational energy and emissions and the impacts of extreme weather. It is also impacting the way owners and managers assess their assets, such as evaluating the risk to purchase or divest of them. Expect increasing attention to be placed by the design professions on limiting snow load, storm damage, and the consequences of heat waves, as well as maintaining a comfortable indoor climate. There may be a need for passive shading and heat-deflecting windows to reduce indoor temperature extremes during heat waves, especially for vulnerable buildings. As well, construction technicians will need to be aware of

91 Simon Roberts. 2008. Effects of climate change on the built environment. In: Energy Policy, Volume 36, Issue 12, December 2008, Pages 4552-4557.

92 See "Climate Emergency Declaration." Retrieved from: https://climateemergencydeclaration.org/tag/canada/

updated design parameters, for example, wind speed, temperature and duration of heat waves, and maximum precipitation intensity.

The Retrofit Economy

The majority of the buildings all around us will still be in operation in 2030, and many of them do not meet contemporary energy efficient or other sustainability standards. That said, a building does not have to be new to be efficient. The process and practice of retrofitting existing buildings offers the sector a cost-effective opportunity to reduce energy costs while improving occupant health and wellness. It is also a critical path to achieving Canada's climate change targets.

Leading building owners are retrofitting and overhauling their properties to drastically drop energy use and GHG emissions. While many building owners still pursue single-technology improvements, market leaders bundle together energy saving and low-carbon technologies to capture deeper savings. When well-implemented, retrofits offer building owners and operators lower operating costs and enhanced property values. Retrofits also improve occupant living, working, and learning conditions, create jobs, and develop new expertise and capacity in the real estate sector. They also can generate attractive returns for lenders and investors.

To date, governments have focused their interventions on retrofit grants and rebates. While important, such incentives should also establish the appropriate market infrastructure to create a self-sustaining retrofit economy. In particular, limited access to financing remains a barrier to building owners. Private sector lenders need to consider energy efficiency and GHG reductions as part of their underwriting criteria. Factoring monetary savings into the borrower's cash flow calculations helps shield financial risk should an asset fall short of regulatory requirements. For example, a building may be less valuable if it does not meet minimum energy efficiency or GHG standards, or if it is vulnerable to carbon price increases.

When approaching retrofits, governments should develop a consistent approach to energy efficiency and carbon reduction. A successful response would yield industry-trusted standards, methodologies, and certifications similar to those that credit rating agencies provide to debt-security investors. It would also serve to address the challenge of institutional investors having little appetite for the modest returns generated from energy savings of individual buildings. Policy makers could lower this barrier by backstopping retrofit loans and by pooling retrofit projects into bundles that would more likely catch investor attention.

In addition, in the coming year we expect to see federal and provincial retrofit codes, and retrofit development standards. Carbon pricing will also help owners see the benefits of electrification. Rather than just swapping like-for-like with mechanical systems, owners will increasingly see these as opportunities for fuel switching, recladding, adding renewable generation, and improving operations.

Implications for the green building industry

As regulators increasingly roll out retrofit codes, energy benchmarking, and performance thresholds across the country, owners and managers will need to improve their buildings' performance. Expect a transition from the current "end of life" replacement approach for mechanical systems to a longer-term planning approach that seeks to decarbonize building operations over time.

Engineers, architects and the trades will shift the focus from new construction to improvements in existing buildings and homes. The construction sector will be challenged to identify cost effective systems and processes to upgrade buildings and homes of diverse age, use, and energy source.

Financial institutions will develop lending products specific to energy efficient and low carbon retrofits, seeking to not only maximize returns but also play a role in driving GHG reductions.

The Circular Economy

The "take-make-dispose" economic model is fundamentally at odds with a low- to zero-carbon energy and materials-efficient society. As awareness of this conundrum increases, some are championing a complete overhaul of the way we design, use, and reuse our resources.

Advocates for the new framework and model, called the circular economy, focus on three principles: Design out waste and pollution, keep products and materials in circulation, and regenerate natural systems.[93] In a circular economy, resources are not discarded in landfills or elsewhere, but are instead recycled, reused, repaired, and shared.

Further, materials, products, systems, and business models consistently contribute their highest level of value and utility, eliminating waste and pollution and other unwanted by-products. For businesses, this not only means designing and building products for reusability, but also making it easier for customers to play a role in end-of-life recovery efforts.[94] The approach benefits both the environment and the economy, fostering energy savings and reducing GHG emissions.

We expect to see growing support for the circular economy in the coming decade. Its success will depend on industry innovation and our ability to accept and overcome political trade-offs and broader societal challenges, including behaviour change.[95]

Implications for the green building industry

The circular economy will challenge product manufacturers to develop resource-efficient products that are easily repaired and disassembled; improve logistics to deliver and return materials; responsibly source raw materials; design to minimize waste in product refurbishment; and embrace alternative business models such as "product as a service."

The circular economy will also challenge architects and builders to design out waste and instead design for resource efficiency, deconstruction, and disassembly, using more renewable energy and reducing embodied carbon.[96]

93 "What is a circular economy?" Ellen MacArthur Foundation. Retrieved from https://ellenmacarthurfoundation.org/circular-economy/concept

94 Yule, Mary Ann. "How the circular economy can help Canada keep its global recycling crown." July 13, 2016. The Globe and Mail. Retrieved from: https://theglobeandmail.com/report-on-business/careers/leadership-lab/how-the-circular-economy-can-help-canada-keep-its-global-recycling-crown/article30825298/

95 Jesus, Anada, et al. "Eco-innovation pathways to a circular economy: Envisioning priorities through a Delphi approach." Journal of Cleaner Production. Volume 228, 10 August 2019, Pages 1494-1513. Retrieved from: https://doi.org/10.1016/j.jclepro.2019.04.049

96 "Practical how-to guide: Build Circular Economy Thinking into Your Projects." UK Green Building Council. Retrieved from: https://ukgbc.org

Embodied Carbon and Sustainable Materials

Green buildings have also long prioritized carbon reduction and non-toxic building materials, and advocates are increasingly paying attention to the carbon embodied in building materials. Wood has long been considered a sustainable material, as it is renewable and carbon sequestering, and performs well in life-cycle assessments. For these reasons, developers and builders are increasingly looking to other sustainable materials in multi-story buildings, including mass timber, which, if sourced sustainably or via Forest Stewardship Council certified forests, has the potential to reduce embodied carbon.[97]

Embodied Carbon

Embodied carbon emissions are those that arise from the manufacture, transport, installation, use, and end-of-life processing of the materials that collectively constitute a building. The CaGBC's Zero Carbon Building Standard [98] extends beyond consideration of operational carbon to account for these embodied emissions.

Embodied carbon represents approximately 11 per cent of all energy-related carbon emissions globally. Emissions that occur during a building's production and construction, referred to as "upfront carbon," are released into the atmosphere before it is even occupied and operating. Designers can reduce this upfront carbon challenge by selecting materials that store or sequester carbon. Materials can lock carbon away for many decades and, in some instances, in perpetuity. In certain cases, materials can actually store more carbon than the amount that would be emitted during their manufacturing and/or processing and transportation to the site. In other words, upfront carbon emissions can be a negative value.

Embodied carbon represents approximately 11 per cent of all energy-related carbon emissions globally. Emissions that occur during a building's production and construction, referred to as "upfront carbon," are released into the atmosphere before it is even occupied and operating.

Many factors impact embodied carbon emissions, including the type and volume of structure installed and the materials used. Calculations of a given material's embodied carbon typically consider the carbon intensity of its manufacturing process, the modes and distances by which it is

97 The sustainability and carbon footprint of mass timber and/or other wood products relies, among other things, upon how it is harvested. Wood-based biogenic carbon emissions depend on responsible forest management practices. Not all wood sustainable certifications are alike, however. LEED® requires wood products to be certified to the Forest Stewardship Council® (FSC®) standard. For more information, see fsc.org.

LEED® also encourages life-cycle assessments (LCAs) for all materials. Emissions from biogenic carbon from wood depend in part on forest management practices. The more sustainable the harvesting and processing of that wood, the better its overall LCA performance. Some currently used datasets assume that biogenic carbon removals and releases are equal. End-of-life assumptions will still impact the way carbon is returned to the atmosphere (CO2 vs CH4), which will have some impact. This will all continue to evolve as datasets improve and as industry uses localized data (that is, data aligned with local practices). We defined procedures and requirements in each of CaGBC's standards, looking at the full context of choosing materials, including the harvesting, processing, transport methods and end of life impacts. CaGBC's Zero Carbon Buildings standard references "Life Cycle Assessment of Buildings: A Practice Guide," which discusses material selection.

98 Canada Green Building Council (2020). Zero Carbon Building - Design Standard Version 2 and Performance Standard Version 2. Canada Green Building Council (2020).

transported to the job site, and the processes by which it is constructed, maintained, and ultimately removed and handled at the end of the building's life.

As a general rule of thumb, a design team can capture a project's greatest embodied carbon savings at its earliest stages. The further along a project progresses, the more challenging and more costly it is to address.

As builders and designers drive down operational carbon via electrification, among other strategies, embodied carbon will continue to loom large. We expect both industry and government will increasingly pursue effective strategies to tackle it.

Sustainable Concrete

The construction industry has long relied on concrete; it is quite literally a foundational material. However, cement, one of concrete's constituent materials, carries a relatively high carbon footprint. Architects and engineers are exploring alternatives that are both durable and gentle on the climate. For example, for centuries builders have used bamboo – a cost-effective, aesthetically pleasing, and easily grown and harvested material. Meanwhile, industry is working to reduce the material's emissions intensity by, for example, substituting general-use cement with Portland limestone cement.

Recycled plastic is also a durable and long-lasting building material. With the growing plastic pollution crisis threatening the natural environment, researchers are starting to create concrete that has added recycled plastics, which lessens the need to mine and extract new building material components.[99]

Mass Timber

Design teams are starting to replace metal and solid-wood components with cross-laminated-timber beams and mass-timber panels in homes and, increasingly, tall multi-storey buildings. Mass timber consists of large structural panels, posts, and beams glued under pressure or nailed together in layers, with the wood's grain aligned perpendicular for strength. Mass timber panel manufacturers use post-industrial waste wood, as well as smaller-dimension trees that are normally too small to be commercially viable – which critics point to as an important consideration. If mass timber is to deliver on its full potential, manufacturers must certify that their source wood is harvested sustainably. It also must drive sustainable forestry management, to minimize carbon released during logging, manufacturing, and transportation.[100] If coupled with harvesting practices certified under a credible stewardship program, mass timber can sequester significant quantities of carbon.

Mass timber components are fabricated off-site and can be quickly installed on the job site, reducing construction time. The material's behavior is also more predictable than concrete, which is sensitive to cold temperatures. Finally, when compared with other materials, mass timber is quieter to assemble on a job site. However, to complete the sustainable picture, at the end of the building life-cycle, the beams would need to either be stored without decomposing or re-used on another project.[101]

99 Varghese, Jeslin. "New Energy Trends for Green Buildings in 2019"
July 24, 2019. The Green Building Research Institute. Retrieved from: https://gbrionline.org/green-buildings-trends

100 Reynolds, Mike and Pierson, Bob. "The Top Twelve Green Building Trends for 2020" January 5, 2020. Ecohome. Retrieved from: https://www.ecohome.net/guides/3486/find-out-whats-trending-in-2020-for-green-home-construction.

101 Robbins, Jim. "As Mass Timber Takes Off, How Green Is This New Building Material?" April 9, 2019. Yale Environment 360.

Many jurisdictions are now allowing, and even encouraging, multi-storey mass timber buildings. In May 2020, the City of Vancouver approved policy allowing mass timber construction up to 12 storeys for residential and commercial use. Brock Commons Tallwood House is an 18-storey student residence at the Point Grey Campus of the University of British Columbia. At the time of its opening in 2017, it was the tallest mass timber structure in the world.

Prefabrication

Prefabricated buildings are assembled in the controlled environment of a manufacturing facility. They are often able to achieve a higher standard of quality than site-built structures, where the raw materials and shell are typically exposed to the weather for extended periods. Prefabricated buildings also avoid weather delays, labor overruns, and weather-damaged materials, and reduce waste to a trickle. Offsite construction also lends itself to improved material handling, as workers can sort, store, and later reuse smaller pieces of wood and insulation.[102]

Implications for the green building industry

We expect offsite and prefabricated construction will become increasingly commonplace as regulators begin requiring very high energy performance requirements, because when the details really matter, the approach offers unparalleled consistency, standardization, and precision.

For the industry, this could increase the attractiveness of construction trades to younger people, who would be working indoors, in climate-controlled factories, instead of out on scaffolding in wind, rain, and snow-blown conditions. It may reduce worksite injury rates, as all construction is done with panels horizontal, at ground level. Prefabrication also supports faster building times, as a developer could be pouring a foundation on a job site while crews assemble the walls elsewhere. Precise continuous insulation installation and air-barrier sealing could also mean less time lost from re-doing efforts to meet airtightness requirements.

The Internet of Things: Digitization and Smart Buildings

Digitally controlled mechanical and electrical systems are now commonplace in new buildings. But in the years ahead we expect these systems will grow both more sophisticated and more intuitive to use.

Internet of Things (IoT)[103] devices can monitor and control the mechanical, electrical, and electronic systems used in building automation systems. They can monitor and control lighting, heating,

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Retrieved from: https://e360.yale.edu/features/as-mass-timber-takes-off-how-green-is-this-new-building-material.

102 Reynolds and Pierson.

103 Internet of Things refers to a system of interrelated computing devices, mechanical and digital machines provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The definition of the Internet of Things has evolved due to the convergence of real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all help enable the Internet of Things and is often associated with "smart homes," covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that can be controlled via devices such as smartphones and smart speakers. https://en.wikipedia.org/wiki/Internet_of_things

ventilation, and air conditioning, as well as media, security, and other systems. The online integration of building energy management systems creates energy efficient and smart buildings, collecting and analysing raw data which enables real-time monitoring of energy systems, to reduce energy consumption and help the building "learn" how to respond and adapt to occupant behavior. A smart building collects information such as temperature or pressure in various rooms, or measurements of how much energy the equipment is using. This helps identify potential issues.

Building automation helps improve occupant comfort, ensure efficient building systems perform, and reduce energy consumption and operating costs. For example, sensors in a given building's ventilation system may identify a single fan in an array that is using much more energy than its neighbors. A visual inspection of the fan would not likely reveal this anomaly, but an alert would prompt further investigation by a building manager. Similarly, a system could send an alert that a room is being both heated and cooled at the same time.

Smart buildings reduce energy costs and lower GHG emissions. They give building managers baseline data, so they know if energy efficiency is improving, and help identify and diagnose problems early so they can be solved right away at a lower cost and before they cascade into other issues.

Truly smart buildings will also leverage knowledge that resides beyond its walls and windows. Electricity markets are evolving toward "real time" smart grids, meaning that buildings will eventually receive and respond to "requests" from the utility to reduce demand when wholesale prices are high, or when grid reliability may be in jeopardy.

One can achieve an energy efficient and occupant-optimized intelligent building by taking a more holistic approach to building controls and collecting, aggregating, and processing all of a building's diverse data. Sensors detect changes, such as occupancy, temperature, air quality, or motion in a room and feed that information to building management systems. Such systems enable facility managers to automate and manage the different variables of a building's operation, including temperature, ventilation and lighting. They store and analyze the data over time, making adjustments that could even include the optimisation of space, capturing further savings.[104] In addition, building operators can display energy data in public areas, which can help cultivate an energy-conscious culture among occupants.[105]

Truly smart buildings will also leverage knowledge that resides beyond its walls and windows. Electricity markets are evolving toward "real time" smart grids, meaning that buildings will eventually receive and respond to "requests" from the utility to reduce demand when wholesale prices are high, or when grid reliability may be in jeopardy.

In addition, dynamic electric rates are a growing trend. Under this approach, utilities charge building owners an electricity rate closer to the actual cost of producing the power used, instead of an average cost calculated over a longer period. For instance, a utility system operator may program their smart grid to access weather forecasting data, and anticipate a temperature increase that will result in increased demand the following afternoon. The utility could then offer to pay a smart

104 Hatcher, John. "The impact of the Internet of Things on buildings." Smart Buildings Magazine. September 9, 2018. Retrieved from: https://smartbuildingsmagazine.com/features/the-impact-of-the-internet-of-things-on-buildings

105 "Smart buildings initiative." Public Services and Procurement Canada. Retrieved from: https://www.tpsgc-pwgsc.gc.ca/biens-property/intelligents-smart/index-eng.html

building a certain price for every kilowatt-hour drop below the building's average electricity usage.

A smart building could be configured to "accept" this offer by activating an internal demand-reduction mode. While energy use and occupant comfort are crucial to any organization and require human involvement in decision making, technologies such as these will give building operators tools and information to make smarter choices. Many utilities are already installing smart meters that allow for a two-way communication and a better control of power consumption.

Implications for the green building industry

For tomorrow's building owners and managers it will not be enough for a building to simply contain the systems that provide comfort, light, and safety. Buildings of the future must connect these various elements in an integrated, dynamic, and functional manner. This will yield buildings and homes that seamlessly fulfill their core objectives while minimizing energy cost, supporting a robust electric grid, and mitigating environmental impact.

This trend will particularly influence engineers and designers, as they seek to meet the needs of their clients and establish the connectivity between all the equipment and systems in a building. A chiller plant optimization, for example, would boost equipment efficiency by accounting for outside weather data and occupancy. Another system might access data from the building security system to conclude the building is unoccupied, and then turn off lights and reduce cooling.

Energy Storage and Resiliency

Renewable energy – either generated on-site or supplied from a low-emitting grid – plays a significant role in lowering a building's operational carbon emissions. And while on-site wind and/or solar generation can improve a building's resilience in the event of, for example, a severe weather event, engineering teams considering such systems must plan to integrate storage.

Energy storage not only smooths out the inherent variability of wind and solar generation, it serves as a backup energy supply in the event of a blackout or brownout following a severe storm or stretch of extremely hot or cold weather. In the event of a grid interruption, passive design strategies such as an efficient building envelope, natural ventilation, shading, and water capture and storage allow buildings to continue to operate until the lights come back on.

We categorize energy storage as thermal, chemical, and mechanical. In buildings, thermal (ice/water) and chemical (batteries) make the most sense.

As its name suggests, thermal energy storage allows excess thermal energy to be tucked away and accessed hours, days, or even months later. Think of it like a battery for a building's air-conditioning system. It allows a building manager to balance energy demand between day and night, store summer heat for winter warmth, or store winter cold for summer air conditioning. Thermal storage uses standard cooling equipment, plus an energy storage tank, to shift all or a portion of a building's cooling needs to off-peak, nighttime hours. During off-peak hours, when energy prices are lower, a building system can make ice and store it inside insulated tanks, then use it to cool occupants the following day.

Thermal storage helps cost-effectively balance high shares of variable renewable electricity production, allowing managers to integrate electricity and heating sectors in energy systems that are almost or completely fed by renewable energy.

As for chemical storage, lithium ion batteries are becoming increasingly accessible and available to the building industry thanks to an innovation push from the electric vehicle industry.

Finally, green hydrogen is the next area of innovation to watch in green building energy storage. With green hydrogen, renewable power sources such as wind and solar produce the elemental gas from water in a process called electrolysis.

The hydrogen must then be stored, potentially in underground caverns for large-scale energy storage, although steel containers can be used at smaller scales. Hydrogen can be used as fuel for piston engines, gas turbines, or hydrogen fuel cells – the latter offering the best efficiency. Hydrogen forms the basis for the hydrogen economy, in which it replaces fossil fuel in many combustion applications.[106] And while hydrogen is often discussed as a transportation fuel, green hydrogen has a significant potential for stationary applications, including buildings.[107]

At the community level, energy storage enables locally produced energy, which in turn supports inproved resilience and higher levels of energy security. And household-scale energy storage allows a homeowner to store the solar power generated on their rooftop during the day and use it long after sunset.

Implications for the green building industry

As the market transforms in response to climate change to eventually reach net-zero and zero carbon performance levels – and especially as governments enact enabling policy – developers will increasingly seek to integrate both energy generation and storage into their projects. This will in turn grow the market across the full energy storage value chain – for manufacturing of commercial building-scale batteries, for the expertise needed to specify and design the systems, and for the skilled electrical trades who will install them.

Though storage certainly has less "curb appeal" than the glossy solar panels at the other end of the wires, batteries are a crucial counterpart to the energy transition, and will be economically attractive when the regulatory frameworks are in place to support them.

106 Breeze, Paul. "Hydrogen Energy Storage." Power System Energy Storage Technologies. 2018. Retrieved from: https://sciencedirect.com/topics/engineering/hydrogen-energy-storage

107 Widera, Barbara. "Renewable hydrogen implementations for combined energy storage, transportation and stationary applications." Thermal Science and Engineering Progress. Volume 16. May 2020. Retreived from: https://doi.org/10.1016/j.tsep.2019.100460

Conclusion: An Opportunity to Build a New Economy

As this report explains, the debate is over. Canada's green building industry is creating healthier and more comfortable places to work, live, learn and play. It is also creating opportunity. The green building industry today contributes about $48 billion to Canada's economy and directly employs almost twice as many full-time workers as the country's oil and gas extraction, mining, and forestry sectors combined.

As the research presented in this report demonstrates, investing in green buildings will ultimately employ close to one-and-a-half million Canadians. Further, smart stimulus investments in the green-building sector could help ensure Canada meets its 2030 climate target while adding almost $100 billion to the economy and improving public health.

In addition, retrofitting the country's large buildings to be more energy efficient has the potential to decrease Canada's GHG emissions 51 per cent by 2030 and new construction, if built to zero carbon standards, could decrease them 17 per cent – all the while equipping large segments of the workforce with the skills of the future.

However, despite significant improvements of building codes and policies as well as strong market uptake of LEED® and similar certification programs, green building has still a long way to go to become mainstream.

A large percentage of Canada's buildings continue to be constructed without green building practices or third-party certification. Building codes and municipal bylaws in provinces such as British Columbia are driving market transformation via new construction. But the existing building market remains the greatest untapped opportunity for economic development, job creation, and GHG reductions.

Canada faces an unprecedented challenge – but also an unprecedented opportunity. As a sector foundational to any economic recovery, the construction industry can be quickly mobilized with shovel-worthy projects that will generate jobs, create healthy spaces for Canadians to live and work, and mitigate the worst impacts of climate change. Investments made today must be directed to projects that will achieve measurable carbon emissions reductions. The building sector can lead the way by creating skilled jobs and driving innovation that will grow the low carbon economy within the coming year, yielding significant GHG reductions and

If you support this vision, please join the growing chorus of green building professionals who are calling for a green recovery focused on green buildings, via **CaGBC.org/greenrecovery**

job creation as part of the economic recovery, making green building the new mainstream by 2030.

But without government intervention, Canada could quickly return to conventional construction methods that lock in inefficient technologies or dirty modes of production and consumption. We would lose the opportunity to transition our buildings to be environmentally sound, socially just, and resilient, as well as healthy and productive places for Canadians to live, work and learn.

APPENDIX 1
Methodology

Canada's Green Building Engine builds on the 2016 Green Building Market Impact Report[108] to assess current market and employment size and impact of Canada's green building industry both nationally and by province, today and its potential for the next 10 years, based on historical data and forward-looking trends for both new construction and retrofits. The report highlights the sector's contribution to the broader Canadian economy by showcasing the impressive market transformation for high-performing green buildings across Canada. It considers the entire value chain of the construction ecosystem, from design through construction and operations for new construction and the retrofit economy.

This project seeks to quantify direct GDP and employment in the green building sector of Canada's economy. This exercise was conducted for both historical periods (since 2015) and future development leading up to 2030. The latter accounts for the impacts of existing and announced climate policies as well as potential future (i.e., unannounced) policies and investment priorities under a Climate Forward scenario in Canada as of April 2020.

Based on considerable secondary research and literature review, interviews with expert practitioners and policy makers, and a detailed, data-driven economic impact assessment, on a national and provincial level, this report:

- Quantifies the size and scope of the green building sector in Canada, using 2018 data as a baseline;[109]
- Captures the growth of the industry and the measurable impact that the sector is having on the economic, social, and environmental fabric of Canada; and
- Compares, contrasts and highlights regionally specific attributes and strengths by leveraging various provincial and national data sources, such as key industry stakeholder interviews, data from green building certifications and the national statistical framework for green building sector based on North American Industry Classification System (NAICS) codes.

The information below provides an overview of the methodology applied for measuring the economic impact of Canada's green building industry with respect to jobs and gross domestic product. The quantitative research and analysis in this report was conducted by The Delphi Group ("Delphi"). The company sourced and inferred data from existing databases and online resources such as government statistics and market and industry reports.

108 CaGBC. Green Building in Canada: Assessing the Market Impacts & Opportunities. 2016.

109 Data was sourced from 2018, the most up to date available at the time of the research. 2018 employment data was used for the NAICS codes. 2018 intensity ratio assumptions were based on the state of the market in 2018 (building codes at a certain stage of adoption, 2018 market reports on key sectors, and certification data up until end of 2018).

Establishing a Green Building Definition

Green buildings are holistic buildings that are designed, constructed, and operated to achieve clearly defined environmental, economic, and social performance objectives that are measurably above and beyond the norm. With respect to this research, construction projects in Canada are included in this definition if they have achieved one or more of the following criteria:

- A certification system with documented and verified increased performance level (LEED®, Zero Carbon Building Standard®, BOMA BEST®, BUILT GREEN®, Novoclimat®);
- An energy rating standard (ASHRAE 90.1, ASHRAE 100, Passive House, EnerGuide 80, ENERGY STAR®, R-2000®); and/or
- Evidence of exemplary equivalent performance by other means in the areas of energy efficiency, water efficiency, material and/or resource efficiency, including through building code and/or municipal bylaw minimum standards.

The outcomes from the various rating systems vary, greatly depending on level of certification, required performance thresholds, and the rigour of certification. The degree of focus on performance relies largely on where the line that denotes "green" is set. This varies across the country by province and territory and is a constantly moving target. For this study, all projects were treated equally, independent of the level of certification, but it is important to note that the meaning of a "green" building covers a certain spectrum in the building stock that will differ in its performance level, also depending on geography and priorities of the project team.

The definition of a green building is largely tied to standardized metrics that are in turn defined by the leading rating systems and certification standards, as well as building codes and regulations. Energy codes across Canada continuously evolve and set minimum performance for buildings. In 2014, Natural Resources Canada (NRCan)'s set along-standing goal from its R-2000 residential program was to have ensure that all new homes in Canada would eventually meeting the EnerGuide 80 standard. A green building completed today will be measurably better than one built to code.

Intensity Ratios[110]

Intensity ratios represent the estimated percentage of each industry that can be assumed as being dedicated to green building activity as defined in this research. These intensity ratios were developed for each industry that comprise Canada's full green building sector value chain according to its North American Industry Classification System (NAICS[111]) code at the three- or four-digit level. Provincial nuances were factored into the intensity ratios. Intensity ratios were then applied to each of these NAICS codes to estimate green building jobs and GDP by province or territory from total employment for each subsector.

Key indicator data was gathered and used to estimate the amount of green building activity in each industry. This work involved a detailed analysis of each relevant NAICS codes;[112] an effort that builds on considerable work that was already been done by the company for the 2016 Green Building Market Impact Report as a starting point, using 2014 baseline data. Analysis was based on the development of intensity ratios for the green building industry in some jurisdictions, including work by the United States Bureau of Labor Statistics (US BLS), GLOBE Advisors,[113] and others. Additional detailed research was conducted to refine, update, and validate the intensity ratios based on secondary research findings and a select number of key stakeholder interviews.

The intensity ratio analysis includes:

- An analysis of the energy efficiency components of provincial building codes for new residential construction;
- An examination of the market penetration of various green building certification programs and rating systems for both new and existing residential and non-residential construction;
- A review of products, technologies, materials, services, and market reports (e.g., on windows, HVAC, energy efficient lighting, wood products, insulation, and others);
- Research on construction and demolition waste diversion and recycling trends;
- Research on government, post-secondary education and training, as well as not-for-profit sector employment related to green buildings; and
- A select number of targeted key stakeholder interviews.

For example, an intensity ratio of 0.18 (or 18 percent) was applied to total employment in British Columbia's Part 9 residential construction industry (NAICS code 2361 Residential Building

110 Detailed data and calculations can be made available by request.

111 It is important to note that the analysis is based on the North American Industry Classification System (NAICS) at the three- to four-digit level (the first two digits designate the sector, the third digit designates the subsector, the fourth digit designates the industry group), not the National Occupational Classification (NOCS) that classifies occupations. There are conceptual differences between an industry classification and an occupational classification. An establishment can employ individuals performing completely different occupations, and these are classified to appropriate occupational groups, but the industrial classification of each individual employed in the establishment should be the same and is determined by the nature of the product made or service rendered. In other words, the nature of the factory, business, or service in which the person is employed does not determine the classification of the occupation, except to the extent that it enables the nature of the duties to be more clearly defined.

112 A complete list of the NAICS can be found in Appendix 2.

113 http://www.bls.gov/green/home.htm, Clean Economy market study methodology: http://globeadvisors.ca/media/4489/globe_bcce_methodology(sept.2012).pdf

Construction) for 2018. This was estimated by taking a weighted average of the percentages of "green" related construction activities in new construction until the end of 2018 (tied to BC's provincial building code and local government policies that reference the BC Energy Step Code), combined with green building and energy efficiency retrofit activities in the existing residential building space. Intensity ratios were adjusted for each industry (i.e., for each NAICS code) by province or territory based on the gathered data and information – that is, new green construction activities combined with green building and energy efficiency retrofit activities in the existing residential building space in each province or territory.

For some industries where green building is a very small percentage of the overall activities in that industry (such as NAICS code 6113 Universities; 5416 Management, Scientific, and Technical Consulting Services; and 5622 Waste Treatment and Disposal), intensity ratios were estimated based only on results from secondary research findings and key stakeholder interviews, both as part of this research and from work done by other organizations in the past.

For the following NAICS codes, the same intensity ratios used in the 2016 edition of this report – which in turn used 2014 as a base year – were retained due to time constraints or industry complexity.

- 2371 Utility system construction
- 2372 Land subdivision
- 3211 Sawmills and wood preservations
- 3212 Veneer, plywood, and engineered wood product manufacturing
- 3342 Communications equipment manufacturing
- 3344 Semiconductor and other electronic component manufacturing
- 3345 Navigational, measuring, medical, and control instruments manufacturing
- 5415 Computer systems design and related services

Estimating the Current Impact of Green Building in Canada

The statistical framework was updated to define the scope of the sector and guide for statistical data collection. The framework was based on relevant North American Industry Classification System (NAICS) codes (including architecture, design, engineering, residential and ICI construction, building suppliers / materials / technology, operations, and related supporting organizations, see complete list in Appendix 2) at the four-digit level.

With the help of the intensity ratios explained above, green-building economic activity in Canada (i.e., total jobs and GDP) was estimated within each industry NAICS code that make up Canada's full green building sector value chain, by sub-sector, for each province or territory, and for Canada as a whole. This work also created its own green building definition (see above), based on the one created for the 2016 report. To allow for a comparison, this definition was kept similar, but updated. For example, CaGBC's Zero Carbon Building Standard was added. The overall economic and employment impact methodology and statistical framework developed for the 2016 Market Impact Report was refined based on this definition, and a few new NAICS were added to reflect the updated

green building industry landscape. In addition, the territories were included when estimating the size of Canada's green building sector.

Using this NAICS code framework, green building GDP and employment in 2018 was determined for each industry by province by applying intensity ratios to total employment for each NAICS code, using the following methods and sources:

Category	Methodology Component	Source
Green Building Market Activity & Intensity Ratio Analysis	Market activity (residential vs. non-residential, new vs. existing)	Statistics Canada. Table 34-10-0175-01 Investment in Building Construction
	Further information on existing building retrofit market activity by province.	Statistics Canada. Table 36-10-0099-01 Flows and stocks of fixed residential capital by type of asset, provincial and territorial (x 1,000,000)
	LEED® requirements for public building construction in Canada	See table below
	Building codes and municipal bylaws for minimum energy performance / green building threshold	See table below
	CaGBC database on LEED® registrations and certifications	Provided by CaGBC
	BOMA BEST® database	Provided by BOMA Canada
	Passive House buildings registrations and certifications by year database	Provided by Passive House
	Novoclimat registrations and certifications by year database	Provided by Novoclimat
	BUILT GREEN® registrations and certifications by year database	Provided by BuiltGreen
	R-2000 and ENERGY STAR® registrations and certifications by year database	Provided by NRCan

Intensity Ratio Analysis	Market penetration of ENERGY STAR® products in United States (2018)	ENERGY STAR® 2018 Unit Shipment data
	Market penetration of ENERGY STAR® products in United States (2017)	ENERGY STAR 2017® Unit Shipment data
	Paint, coating and adhesive manufacturing market	Paints and Coatings Industry Profile
	Energy-efficient Technologies for Global Residential Markets – Dec 2017 BCC Research – Canadian Residential Market for advanced energy efficient windows and window covering	Energy-efficient Technologies for Global Residential Markets
	Mineral Wool Manufacturing Companies – insulation manufacturing	Manta Database
	Solid waste diversion and disposal – C&D Waste Diversion Trends	Statistics Canada (2018) Table 38-10-0032-01. Disposal of waste, by source. Statistics Canada (2018) Table 38-10-0033-01. Materials diverted, by source.
	Natural Sciences and Engineering Research Council of Canada's Awards Database	Natural Sciences and Engineering Research Council of Canada
	Federal Services, Provincial and Territorial Public Administration, and Local Municipal Public Administration	Alberta Government – Building Support 2020, BC Government Directory – Office of Housing and Construction Standards 2020, BC Government Directory – Built Environment 2020, Saskatchewan Property Management 2018, Saskatchewan Building Standards and Licensing 2018 , Manitoba Municipal Relations Energy Division 2020, Manitoba Office of Fire Commissioner 2020 , Government of Ontario Departments 2020
	Window Market Globe – Freedonia (Dec 2018), Window Market Canada – Freedonia (Dec 2017)	Windows and Doors Global, Windows and Doors Canada
	Market availability of ENERGY STAR® products in Canada	Natural Resources Canada

Employment & GDP Calculations	Input-output multipliers, provincial and territorial, detail level.	Statistics Canada. Table 36-10-0595-01 Input-output multipliers, provincial and territorial, detail level
	Canadian Business Counts, with employees, by province	Statistics Canada. Table 33-10-0214-01 Canadian Business Counts, with employees, June 2019
	Canadian Business Counts, without employees, by province	Statistics Canada. Table 33-10-0215-01 Canadian Business Counts, without employees, June 2019
	Labour statistics consistent with the System of National Accounts (SNA), by job category and industry	Statistics Canada. Table 36-10-0489-01 Labour statistics consistent with the System of National Accounts (SNA), by job category and industry

A detailed, data-driven economic impact assessment, secondary research and literature review, and industry stakeholder interviews were used to determine the NAICS code framework, and total GDP and employment in 2018 for each industry by province or territory. The following methods and sources were used:

- Estimate of total market penetration of all certified green building standards as a per cent of total construction (new and retrofit) as a five-year average for residential as well as non-residential construction, by province or territory;
- Estimate of impact of building codes and other standards on green building market penetration (outside of green building certification programs) for residential and non-residential construction, by province or territory;
- Development of market penetration "intensity ratios" for construction trades (based on weighted average between new and retrofit construction spending), by province or territory;
- Estimated green building related market penetration (i.e., intensity ratios) for all other industries (at the four-digit NAICS code level) across the green building value chain by province or territory;
- Application of these provincial intensity ratios to the total jobs by industry in 2018 (based on StatsCan System of National Accounts) to estimate the number of green building direct jobs by province;
- Convert direct jobs into GDP and gross output (revenues) by province or territory (direct, indirect, and induced) using StatsCan multipliers;
- Estimate the total square footage by building type in Canada by province or territory using relevant data sources based on building appraisals and building permit data;

- Tabulating 10-year trends to date for residential and non-residential (ICI) building construction by type by province or territory using Statistics Canada data; and

Intensity ratios were used for each industry (i.e., for each NAICS code) by province or territory based on the gathered data and information. Particular attention was paid to the distinction between new construction and retrofit activities, as well as regional strengths and capabilities.

Recent research and studies were reviewed to inform the intensity ratios and the overall approach. In addition, targeted key informant interviews were conducted to further inform the data collection efforts and gather specific qualitative and contextual information by region and sector.

Evolving Landscape of Provincial and National Building Codes and Municipal Bylaws and Policies

The minimum threshold of green buildings in each region, including consideration for the role of provincial building codes and municipal bylaws, informed this research.

- The federal government released the National Energy Building Code for Canada (NECB) in 2017. We assumed this as the minimum threshold for energy efficiency as the NECB prescribes minimum performance levels for all building types.
- The federal government is working to update building codes to lower building GHG emissions across Canada by 2030. Under the Pan-Canadian Framework on Clean Growth and Climate Change, the government committed to adopt increasingly stringent buildings code starting in 2020, with the goal of adopting "net zero energy ready" building codes by 2030 and developing a model energy code for existing buildings by 2022. These objectives guide current building codes updates.

	Provincial Codes
BC	BC Building Code. The base code combines the core concepts of the National Building Code with elements specific to the province's unique needs. BC Energy Step Code. By 2032, the BC Building Code will require all construction to meet a net-zero energy-ready performance level. The BC Energy Step Code is both a regulation and a standard that allows local governments to incentivize or require a level of energy efficiency that exceeds minimum code requirements. It is a voluntary provincial standard enacted in April 2017 by British Columbia that provides an incremental and consistent approach. Local governments that choose to reference the BC Energy Step code in their policies will create more efficient, durable, healthier buildings while supporting the overall province on its goal. Implementation Update – 2020
AB	Alberta Building Code. Alberta adopted NECB 2017 in early 2019. No standard over and above NECB (2017).

SK	Adopted NECB 2017 in early 2019. No standard over and above NECB (2017) or NCB (2015).
MB	No standard over and above NECB (2011) or NCB (2011). MB made minor modifications to NECB 2011 (MECB) when it adopted the code. There is no indication that it will adopt NECB 2015 or 2017. The province requires that publicly owned and funded buildings must be built to Power Smart Guidelines.
ON	Ontario Building Code. No standard over and above NECB (2017). Made in Ontario Environment Plan (2018) includes action to update Ontario Building Code to enhance energy efficiency. According to Efficiency Canada's 2019 Provincial Energy Efficiency Policy Scorecard for commercial, institutional and multi-unit residential buildings, "the Ontario standard claims a 13 per cent average improvement above the 2011 NECB, suggesting performance equivalence to NECB 2011. While a direct comparison between ON SB-12 and NECB 2017 is not available, we have given Ontario same points as provinces that adopted NECB." For houses and small buildings, "Ontario has building codes substantially different from model code. It exceeds NBC." Minimum requirement of EnerGuide 80 for new residential construction.
QC	Quebec Building Code. Current version is not considered to be equivalent in stringency to any of the NECB. The Transition Energetique Quebec (TEQ) Master Plan includes adoption of NEBC by 2019/2020.
Nova Scotia	No standard over and above NBC (2015). Nova Scotia used 2015 NECB as its energy code. On Jan 1, 2020, the province adopted NECB 2017.
New Brunswick	No standard over and above NBC (2015). Not yet adopted the NECB or energy targets.
Prince Edward Island	No standard over and above NBC (2015). Not yet adopted the NECB or energy targets. PEI is planning to rollout NBC (2015) sometime in 2020 making it the last province in the country to adopt the code. Its energy strategy calls for adoption of NECB 2015.
Newfoundland & Labrador	No standard over and above NBC (2015). Not yet adopted the NECB or energy targets.
Territories	The Northwest Territories and Nunavut both use a similar document: "The Good Building Practice for Northern Facilities for the Northwest Territories" and the "Good Building Practice Guideline for Nunavut." Both are only guidelines without any compliance requirements, but both mention the 1997 Model National Energy Code for Buildings and the 2011 NECB. The government of the Northwest Territories published its 2030 Energy Strategy outlining policies and programs to be implemented before 2030. One of its objectives is to increase energy efficiency in commercial, residential, and institutional buildings 15 per cent by 2030.

According to Efficiency Canada's 2019 Provincial Energy Efficiency Policy Scorecard, British Columbia's building code is the strongest, followed by Ontario's.

Notable Local Government Policies and Frameworks

Our analysis captures progressive local government policies that exceed provincial code to inform new construction (e.g. Toronto's green building standard or Vancouver's Zero Emissions Building Strategy). The following information – as well as other additional local governments with green building mandates not included below – was used to substantiate key findings, but they were not used to inform intensity ratios, to avoid double-counting.

Municipality	Province	Standard	Details
City of Toronto	ON	Toronto Green Standard	The Toronto Green Standard sets out the city's sustainable design requirements for new private and city-owned developments. A more stringent version of the TGS (Version 2.0) came into effect in 2014, which raised energy efficiency 15 per cent above Ontario Building Code (OBC, 2012) requirements for Tier 1 and 25 per cent above the OBC for Tier 2. Toronto's Zero Emissions Buildings Framework sets out a performance pathway to achieving near-zero emissions in major building types by 2030.
City of Ottawa	ON	Green Building Policy for the Construction of Corporate Buildings	Introduced in 2005, this policy requires that all new city buildings 5,400 ft2 or larger must meet a minimum LEED® Certified standard. (Source)
City of Whitehorse	YK	Consolidated to Bylaw 2016-20 passed May 24, 2016 - Article 86.3	This city bylaw states: "All commercial construction must adhere to the current edition of the National Building Code or the National Energy Code"(Source). This Bylaw enforces the latest 2017 NECB as the standard for commercial buildings.
City of Yellowknife	NWT	Municipal policy, By-law No 4469, Section 6.2	Yellowknife has a policy to ensure all new municipal buildings are LEED® certified. This city Bylaw requires all commercial buildings to be at least 25% more energy efficient than the 1997 National Model Energy Code of Canada for Buildings.

City of Winnipeg	MB	City of Winnipeg Green Building Policy: New City-owned Buildings and Major Additions	This policy implemented in 2011 mandates all new municipal buildings to be LEED® Silver or obtain three Globes with the Green Globes Design (Source).
City of Edmonton	AB	LEED® Silver Sustainability in existing City-Owned buildings: BOMA BEST® certification program. Building Energy Retrofit Accelerator	Sustainable Building Policy 2017 https://www.edmonton.ca/programs_services/environmental/building-energy-retrofit-accelerator.aspx
City of Calgary	AB	Green building policy	Sustainable Building Policy
City of Montreal	QC	Net Zero Carbon Buildings Declaration	In 2018, Montreal signed the Net Zero Carbon Buildings Declaration and pledged that all new construction will meet that performance threshold by 2030 (Source).
City of Montreal	QC	Municipal policy	Montreal has a policy to ensure all new municipal buildings are certified LEED® Gold.
City of Vancouver	BC	Zero Emissions Building Plan (since April 1, 2014), Net Zero Carbon Buildings Declaration	The current version of the bylaw is the first step in a multi-step approach to reach zero-emissions buildings in all new construction by 2030. City of Vancouver Green Buildings Policy for Rezoning (2018) Vancouver's Greenest City Action Plan Enabling Deep Efficiency Improvement The City of Vancouver requires LEED® Gold Certification for all public buildings, tenant improvements, and facilities funded by city capital funds that are 500 square meters or larger. In 2018, Vancouver signed the C40 Net Zero Carbon Buildings Declaration and pledged that all new construction will be net zero carbon by 2030. Source (C40, 2018)
Halifax	NS		In 2019, the Halifax Regional Municipality declared a state of climate emergency and set a target of net zero carbon by 2050.

Province	LEED Requirements for Public Buildings
BC	LEED® Gold
AB	LEED® Silver
MB	LEED® Silver
ON	LEED® Silver
NL	LEED® Silver
NS	LEED® Silver
NB	LEED® Silver
QC	LEED® Certified
SK	No requirement
PEI	No requirement
YK	LEED certified

Green Building Growth Scenarios to 2030

For this research, three scenarios were developed that included economic projections from 2018 to 2030 for jobs and GDP associated with the green building value chain and sectors that represent the green building industry in Canada and its provinces as defined earlier in this report. The projections were based on averaged or blended growth rates from leading consultancies, banks, and Employment and Social Development Canada (ESDC). All 10 provinces were modeled but not territories. Data includes direct jobs and GDP growth between 2018 and 2030 for each province[114] under each of the following three scenarios:

1. **Pre-COVID scenario:** This scenario was based on economic and industry growth projections by province in terms of direct jobs, GDP, and gross output published in the beginning of 2020 prior to the COVID-19 economic crisis and oil price collapse, as well as the current climate plans, targets and planned building code updates already planned and announced or expected. The movement toward zero carbon construction and green building retrofits continues as per existing plans announced by provinces and municipalities in early 2020.

   The scenario includes the forecasted general employment growth between 2018 and 2030 by province for relevant sectors of the green building supply chain. The employment forecasts were based on projections from the ESDC COPS model, along with workforce projections by Statistics Canada, the Conference Board of Canada, and BuildForce.

2. **COVID-19 or Baseline scenario:** This scenario was based on economic and industry growth projections published May 2020 for the green building sector in Canada by province in terms of direct jobs, GDP, and gross output between 2018 and 2030, adjusted for the impact of the Corona pandemic and oil price collapse in Canada, as well as current climate plans, targets and planned building code updates. The scenario was based on current economic and industry growth projections (e.g., ESDC COPS model along with BuildForce provincial or regional considerations and factor in the pandemic and resulting economic crisis, as well as the oil price collapse, and are based on projections by the Conference Board of Canada and ScotiaBank). These considerations do not include targeted or anticipated future green building recovery spending. The movement toward zero carbon construction and energy efficient green building retrofits slows to some degree in certain provinces in near-term.

   Approximately 20 per cent of all retrofit activity is assumed to be green-building-related in 2030 and 65 per cent of total construction activity in Canada is assumed to be related to retrofits. Further, governments are assumed to provide no targeted fiscal stimulus to support green building retrofit projects as part of economic recovery spending.

3. **Accelerated Green Building Growth Scenario ("Climate Forward Scenario"):** This scenario assumes accelerated movement by provinces and the federal government within a green recovery stimulus package to achieve the national GHG emission reduction targets by 2030 and more closely align with zero carbon construction

114 For reasons of data availability, the territories were not included in this part of the research.

goals and related updates to the NCB/NECB by 2030, as well as increased investments into building retrofits – in line with CaGBC's Roadmap for Retrofits for Part 3 buildings, the NCB for Existing Buildings, and increased investment by governments at all levels into Part 9 and Part 3 green building retrofits. Governments were assumed to target future COVID-19 response stimulus packages towards green building efforts and also significantly invest in climate change mitigation and adaptation.

Forecasted employment growth on the Climate Forward scenario was based on the Baseline scenario economic projections between 2018 and 2030, and include additional projected job creation from targeted economic recovery stimulus spending focused on green building retrofits and net zero carbon construction for both the residential and non-residential sectors.

In sum, governments are assumed to reach 2030 GHG emission reduction goals, 30 per cent of all retrofits are green and low-carbon, and approximately 90 per cent of all new construction is net zero carbon by 2030 in all provinces.

- **New construction sector**: Some minor incremental cost is assumed to be required to get to zero carbon buildings, equal to a four per cent investment and corresponding job creation for new Construction and Trades sector above the Baseline scenario. Economic impact comes largely from the "greening" of the existing workforce shifting to low-carbon buildings rather than new job creation. By 2030, it is assumed that 90 per cent of all new construction across Canada will be zero carbon.
- **Retrofit sector:** Major incremental spending on green retrofits is assumed to be in line with CaGBC's Roadmap for Retrofits for Part 3 buildings that varies by province and a pathway for Part 9 building retrofits focused on building envelope upgrades and fuel switching (electrification in low-carbon provinces and on-site renewables for higher-carbon provinces). Industry is assumed to deep retrofit 377.1 million square meters and 60 per cent of all residential buildings in Canada; this is equal to approximately seven million single-family homes or multi-dwelling buildings and 2.47 million apartments, in line with the Build Back Better Homes Program.[115] Industry is assumed to deep retrofit the equivalent of approximately seven million single-family homes / multi-dwelling buildings and 2.47 million apartments, in line with the Build Back Better Homes Program.[116] The Climate Forward scenario assumes 30 per cent of all retrofit activity will be green-building related in 2030, and that 65 per cent of total construction activity in Canada is related to retrofits. The scenario anticipates incremental investment in deeper retrofit and fuel switching and electrification equipment (e.g., heat pumps) with the non-residential and residential retrofit scenarios – activities that would not occur without the added investment of government. Sixty per cent of residential buildings are assumed to receive a deep retrofit between 2020 and 2030, and calculated retrofits using a blended direct jobs multiplier of 4.5 direct jobs per $1 million spend.

115 Torrie and Bak. Corporate Knights.

116 Ibid.

The three economic projections from 2018 to 2030 include estimated jobs associated with the value chain and sectors that represent the green construction industry in Canada and its provinces as defined in this research. These sectors include:

1. Construction and Trades
2. Materials and Manufacturing
3. Professional Services
4. Utilities
5. Waste and Recycling
6. Policy and Education

Underlying economic and employment forecasting data were collected for each scenario, for the relevant sectors that make up Canada's green building supply chain. Relevant forecasts were applied for each scenario to the total employment estimates for each province's green building sector. These major sources were considered:

- ScotiaBank's economic forecasts based on impacts from COVID-19 and the global drop oil prices (published April 17, 2020).[117]
- The Conference Board of Canada, COVID-19 Implications for Canada and the economic impact.[118]
- Employment and Social Development Canada, Canadian Occupational Projection System (COPS) - 2019 to 2028 projections.[119]
- Statistics Canada Medium Term Population Projections, Table 17-10-0057-01 Projected population, by projection scenario, age and sex, as of July 1 (x 1,000).[120]
- Statistics Canada System of National Accounts historical employment growth.
- BuildForce Canada 2020 Construction and Maintenance Forecasts (Based on the COPS Model).[121]

In addition, Statistics Canada's Labour Force Survey[122] (per cent change in hours worked) was reviewed, as were Credit Union 1,[123] TD Bank,[124] and RBC economic projections[125] related to the COVID-19 crisis and oil price collapse.

The investment spending needed to meet Canada's 2030 GHG emissions reduction targets and the

117 https://www.scotiabank.com/ca/en/about/economics.html

118 https://www.conferenceboard.ca/focus-areas/canadian-economics/provincial-outlook

119 https://open.canada.ca/data/en/dataset/e80851b8-de68-43bd-a85c-c72e1b3a3890
http://occupations.esdc.gc.ca/sppc-cops/content.jsp?cid=industrydatasearch&lang=en

120 https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710005701

121 https://www.buildforce.ca/en/lmi/forecast-summary-reports, https://doi.org/10.25318/1410020201-eng, https://www.constructionforecasts.ca/en/highlights

122 https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410028703

123 https://www.central1.com/economic-insights/

124 https://economics.td.com/ca-long-term-forecast

125 RBC Economics PowerPoint to the Canadian Association of Business Economists, Toronto

resulting employment impacts were analyzed to develop the job creation forecasts in our Climate Forward Scenario. These were then broken out by supply chain sector and by province. This involved building on the analysis done by WSP for CaGBC as part of its Retrofit Roadmap[126] and preparing a simulation model showing the potential annual jobs and GDP impact for Canada's provinces cutting GHG emissions from the existing building sector to 2030. Data on square meters of building floorspace and GHG emissions is available on NRCan's Energy and GHG Database for Buildings;[127] in particular, the module for Commercial and Institutional Buildings. Outputs from the economic impact assessment related to deep residential retrofits to 2030 in Canada were developed as part of the proposed Build Back Better Homes and Workplaces program and used for the Part 9 residential retrofit component,[128] broken out by province based on population distribution.

Intensity ratio assumptions were developed to estimate the amount of green building activity growth by sector and by province between 2018 and 2030. These were based on a range of factors including market and technology trends, proposed building code and bylaw updates, climate action plans and targets, and spending on energy efficiency measures. Intensity ratio changes were developed for the Pre-COVID, Baseline, and Climate Forward scenarios. These intensity ratios were multiplied by total employment to estimate the amount of green building specific employment by sector and by province under each of the three scenarios.

Employment, output, and GDP multipliers were used to convert the projected 2030 direct employment from each scenario to GDP and gross output (based on both 2018 and 2030 dollars).[129]

Intensity ratio increases were averaged over the entire 12-year study period (2018 to 2030) for all three scenarios as described above, based on green building policies and increased net zero carbon building code adoption, therefore splitting out jobs and investments evenly over the period. The stimulus packages were assumed to kick in in 2021, as this was the information available in April 2020. Also, the expected stimulus spending was considered to be evenly invested over the 10-year period starting in late 2020 to 2030. For that reason, the Climate Forward scenario's green building policy assumptions result in a jump to the numbers above the Baseline scenario starting in 2021. The scenarios should be read with the outcomes in mind, not broken down to individual year basis, which should offer a reasonable sense of overall impact over the course of the next decade to 2030.

126 Canada Green Building Council (2017). *Roadmap to Retrofits in Canada.*

127 https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive/trends_com_atl.cfm

128 https://www.corporateknights.com/channels/built-environment/recovering-stronger-building-low-carbon-future-green-renovation-wave-15875463/

129 Statistics Canada. Table 36-10-0595-01 Input-output multipliers, provincial and territorial, detail level: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610059501, Input Output Multipliers: https://doi.org/10.25318/3610059501-eng. We converted the 2018 dollars to 2030 dollars based on expected inflation and labour productivity growth as depicted in the Department of Finance report "Update of Long-Term Economic and Fiscal Projections 2018: https://www.canada.ca/en/department-finance/services/publications/long-term-projections/2018.html.

APPENDIX 2
NAICS Codes

4-digit NAICS Code	Subsector
2211 Electricity utilities	Utilities
2212 Gas utilities	Utilities
2361 Residential building construction	Construction & Trades
2362 Non-residential building construction	Construction & Trades
2371 Utility system construction	Construction & Trades
2372 Land Subdivision	Construction & Trades
2379 Other heavy and civil engineering construction	Construction & Trades
2381 Foundation, structure, and building exterior contractors	Construction & Trades
2382 Building equipment contractors	Construction & Trades
2383 Building finishing contractors	Construction & Trades
2389 Other specialty trade contractors	Construction & Trades
3141 Textile furnishings mills	Materials & Manufacturing
3211 Sawmills and wood preservations	Materials & Manufacturing
3212 Veneer, plywood and engineered wood product manufacturing	Materials & Manufacturing
3219 Other wood product manufacturing	Materials & Manufacturing
3255 Paint, coating and adhesive manufacturing	Materials & Manufacturing
3261 Plastic product manufacturing	Materials & Manufacturing
3273 Cement and concrete product manufacturing	Materials & Manufacturing
327 Non-metallic mineral product manufacturing (except cement and concrete products)	Materials & Manufacturing
3323 Architectural and structural manufacturing	Materials & Manufacturing
3324 Boiler, tank and shipping container manufacturing	Materials & Manufacturing
3334 Ventilation, heating, air-conditioning and commercial refrigeration equipment manufacturing	Materials & Manufacturing
3342 Communications equipment manufacturing	Materials & Manufacturing
3344 Semiconductor and other electronic component manufacturing	Materials & Manufacturing
3345 Navigational, measuring, medical and control instruments manufacturing	Materials & Manufacturing
3351 Electric lighting equipment manufacturing	Materials & Manufacturing
3353 Electrical equipment manufacturing	Materials & Manufacturing
3359 Other electrical equipment and component manufacturing	Materials & Manufacturing
3372 Office furniture (including fixtures) manufacturing	Materials & Manufacturing
416 Building material and supplies merchant wholesalers	Materials & Manufacturing
444 Building material and supplies dealers (retail)	Materials & Manufacturing

5223 Activities related to credit intermediation (incl. mortgage brokers)	Professional Services
5241 Insurance carriers (incl. property insurance)	Professional Services
5311 Lessors of real estate	Professional Services
531 Offices of real estate (incl. agents and brokers)	Professional Services
5413 Architectural, engineering and related services	Professional Services
5414 Specialized design services	Professional Services
5415 Computer systems design and related services	Professional Services
5416 Management, scientific and technical consulting services	Professional Services
5417 Scientific research and development services	Professional Services
561 Facilities and other support services	Professional Services
6112 Community colleges and C.E.G.E.P.S	Policy & Education
6113 Universities	Policy & Education
6115 Technical and trade schools	Policy & Education
813 Grant-making, civic, and professional organizations	Policy & Education
911 Other federal services	Policy & Education
912 Provincial and territorial public administration (9121 to 9129)	Policy & Education
913 Local, municipal and regional public administration (9131 to 9139)	Policy & Education
914 Aboriginal public administration	Policy & Education
418 Miscellaneous wholesalers-distributors	Waste & Recycling
562 Waste management and remediation services	Waste & Recycling
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